

CITY OF FRAMINGHAM
DEPARTMENT OF PUBLIC WORKS

INVITATION FOR BIDS

FOR

SRF REVIEW SUBMISSION
WORCESTER ROAD SEWER PUMPING
STATION REPLACEMENT

BID # PW-1025
CWSRF - 6999



CITY OF FRAMINGHAM
DEPARTMENT OF PUBLIC WORKS
110 WESTERN AVENUE
FRAMINGHAM, MA 01702



www.BETA-Inc.com

THIS PAGE INTENTIONALLY LEFT BLANK

CITY OF FRAMINGHAM
DEPARTMENT OF PUBLIC WORKS

INVITATION FOR BIDS

WORCESTER ROAD SEWER PUMP STATION REPLACEMENT

SRF Project No.: CWSRF-6999

IFB # PW-1025



BID DOCUMENT PW-1025

CITY OF FRAMINGHAM
DEPARTMENT OF PUBLIC WORKS
100 WESTERN AVENUE
FRAMINGHAM, MA 01702

TABLE OF CONTENTS

SECTION A: INFORMATION FOR BIDDERS	1
1. Bid Submittal	1
2. Pre-Bid Conference	1
3. Bid Deposit	2
4. Form, Modification, Withdrawal of Bids	2
5. Questions by Bidders and Addendum	2
6. Prevailing Wage	3
7. Bidder Prerequisites.....	3
8. Enclosures.....	4
9. Signatures.....	4
10. Reservations.....	4
11. Rejection of Bids	4
12. Examination of Bid Documents and Site of Work	5
13. Rule for Award	5
14. Interpretation of Estimated Quantities	6
15. Failure to Furnish Bonds and Insurance Certificates	6
15.01 Certification of Foreign Corporation.....	6
16. Massachusetts Sales and Use Tax.....	6
17. Project Description.....	7
18. Minority and Women Workforce Participation.....	7
19. Laws and Regulations	7
20. Contractor's Guarantee	7
21. Health and Safety	8
22. Equipment Manufacturer Experience	8
23. Permits and Approvals	8
24. Diesel Retrofit Program	8
25. Monthly Price Adjustment for Diesel Fuel, Gasoline, Asphalt, Concrete, and Steel.....	8
26. City Forms.....	8
Example 1 - Notice To Proceed	9
Example 2 - Substantial Completion.....	10
Example 3 - General Release.....	11
SECTION B: SHORT FORM OF AGREEMENT	13
ARTICLE 1: CONTRACT DOCUMENTS	14
ARTICLE 2: SCOPE OF WORK	15
ARTICLE 3: TERM OF AGREEMENT	15
ARTICLE 4: THE CONTRACT SUM	15
ARTICLE 5: PAYMENT	16

ARTICLE 6: CONTRACTOR’S REPRESENTATIONS.....	16
ARTICLE 7: TERMINATION	18
ARTICLE 8: NOTICE.....	18
ARTICLE 9: PERFORMANCE AND PAYMENT BONDS	18
ARTICLE 10: INSURANCE.....	19
ARTICLE 11: INDEMNIFICATION	23
ARTICLE 12: MANDATORY ETHICS TRAINING	23
ARTICLE 13: AFFIRMATIVE ACTION AND EQUAL EMPLOYMENT OPPORTUNITY	24
ARTICLE 14: MISCELLANEOUS.....	24
Exhibit A - Performance Bond.....	26
Exhibit B - Payment Bond.....	27
Exhibit C - Summary Of The Conflict Of Interest Law	28
Exhibit D - Acknowledgement of Receipt of Summary	38
Exhibit E - Affirmative Action & Equal Employment Opportunity Requirements.....	39
Exhibit F - Disadvantaged Business Enterprise Program Background	44
SECTION C: PREVAILING WAGE REQUIREMENTS	59
SECTION D: OFFICIAL BID PACKAGE	60
1. CHECKLIST.....	60
2. SIGNATURE OF BIDDER.....	61
3. CERTIFICATE OF CORPORATE AUTHORITY	64
4. PRICE SHEET	65
5. BIDDER INFORMATION.....	69
6. BIDDER REFERENCE FORM.....	70
7. BID BOND	73
8. ATTESTATION OF TAX COMPLIANCE.....	75
9. CERTIFICATE OF NON-COLLUSION	76
10. MA DIESEL RETROFIT PROGRAM STATEMENT OF INTENT TO COMPLY	77
SECTION E: GENERAL CONDITIONS.....	78
SECTION F: SUPPLEMENTARY CONDITIONS	79
<i>SC-3.06 Copies of Documents.....</i>	<i>80</i>
<i>SC-4.02 Subsurface and Physical Conditions</i>	<i>80</i>
<i>SC-4.06 Hazardous Environmental Conditions</i>	<i>80</i>
<i>SC-6.02.I Labor; Working Hours</i>	<i>81</i>
<i>SC-6.06 Concerning Subcontractors, Suppliers and Others</i>	<i>89</i>
<i>SC-7.02 Coordination.....</i>	<i>90</i>
SECTION G: SPECIFICATIONS	91
APPENDIX A: Worcester road Pump Station-Hazardous Materials Survey.....	92
APPENDIX B: City of Framingham Construction Standards	93
APPENDIX C: Framingham Conservation Order of Conditions	94
APPENDIX D: SCADA Panel Drawings.....	95
APPENDIX E: Geotechnical Report and Boring Logs	96
APPENDIX F: City of Framingham Noise Ordinance	97
APPENDIX G: Risk Based Cleanup Plan	98
APPENDIX H: MassDOT Access Permit.....	99

OF FRAMINGHAM
Department of Public Works

Invitation for Bid No. [PW-1025]

for

[WORCESTER ROAD SEWER PUMP STATION REPLACEMENT]

SECTION A: INFORMATION FOR BIDDERS

1. Bid Submittal

The City of Framingham Department of Public Works, through the Mayor of Framingham Massachusetts, the Awarding Authority invites sealed bids for **PW-1025 Worcester Road Pump Station Replacement**. Bids will be accepted electronically through the City of Framingham Department of Public Works Vendor Registry portal <https://vrapp.vendorregistry.com/Bids/View/BidsList?BuyerId=75c3b765-3725-4b32-9689-fc820e50b9c8> and received no later than the time set forth below, when they will forthwith be opened. The bid opening can be viewed on the following Zoom link: **Insert Zoom Link**

Bids must be submitted electronically through the City’s Vendor Registry system. Bids submitted through any other means, such as mail, email or hand delivery, will not be accepted and will be rejected by the City as non-responsive.

The City of Framingham (“the City”) will be accepting competitive bids **electronically** through the City of Framingham’s Department of Public Works Vendor Registry portal <https://vrapp.vendorregistry.com/Bids/View/BidsList?BuyerId=75c3b765-3725-4b32-9689-fc820e50b9c8> until **1:00 P.M. on XXXX XX, 2022** for the above titled project as described in Paragraph 17.

Bids shall be submitted in compliance with and shall be governed by the City’s Short Form of Agreement for Goods and Services and Specifications included herein. All terms used in this Agreement will have the meanings stated in the Short Form of Agreement for Goods and Services.

Bids received after the date and time set forth above will be considered **LATE BIDS and WILL NOT BE OPENED.**

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

2. Pre-Bid Conference

[Pre-Bid Conference will be held for this project at XXXXXXXX at XXXXX, 2022 AM/PM]
[]

3. Bid Deposit

Each bid shall be accompanied by a Bid Deposit in the form of a bid bond, certified check, treasurer's check, or cashier's check issued by a responsible bank or trust company, in the sum of Five Percent (5%) of the total amount of the bid, payable to the City of Framingham. The Bid Deposit shall be enclosed in a separate sealed envelope, appropriately labeled and enclosed in the envelope containing the bid.

A bid bond, in the form set forth in the Bid Package, shall be issued by a surety company or companies registered to do business in Massachusetts and which is acceptable to the City. Surety companies rated B+ or better by A.M. Best Company or rated A or better by Standard & Poors are normally acceptable. The bid bond shall be signed by a resident agent of the surety company who is licensed as a surety broker in Massachusetts. A bid bond not meeting these requirements may be declared non-responsive and be cause for the City to reject the bid.

All Bid Deposits of bidders, except those of the three lowest responsible and eligible bidders, will be returned within five (5) business days, following the bid opening. Except as provided in the items herein entitled "Failure to Furnish Bonds and Insurance Certificates" and "Certification of Foreign Corporation", the Bid Deposits of the three lowest responsible and eligible bidders will be returned upon the execution of the Contract or, if no award is made, upon the expiration of the time prescribed for making an award.

4. Form, Modification, Withdrawal of Bids

A bidder may correct, modify, or withdraw a bid by written notice received by the City prior to the time and date set for the bid opening. Bid modifications must be submitted in a sealed envelope clearly labeled "Modification No. ___." Each modification must be numbered in sequence, and must reference the original IFB.

After the bid opening, a bidder may not change any provision of the bid in a manner prejudicial to the interests of the City or fair competition. Minor informalities will be waived or the bidder will be allowed to correct them. If a mistake and the intended bid are clearly evident on the face of the bid document, the mistake will be corrected to reflect the intended correct bid, and the bidder will be notified in writing; the bidder may not withdraw the bid. A bidder may withdraw a bid if a mistake is clearly evident on the face of the bid document, but the intended correct bid is not similarly evident.

5. Questions by Bidders and Addendum

Questions concerning this invitation for bids must be submitted in writing before [4:00] P.M. on [XXX, XX, 2022] on Vendor Registry <https://vrapp.vendorregistry.com/Bids/View/BidsList?BuyerId=75c3b765-3725-4b32-9689-fc820e50b9c8>. Written responses will be posted on Vendor Registry for all bidders on record as having viewed/downloaded the IFB. If any changes are made to this IFB, an addendum will be posted on Vendor Registry.

Neither the Procurement Administrator nor any other employee of the City is authorized to give interpretations of any portion of the Contract or to give information as to the requirements of the Contract in addition to that contained in the Contract. Interpretations of the Contract or additional information as to its requirements, where necessary, shall be communicated to bidders by written addendum, which addendum shall be considered part of this Contract.

6. *Prevailing Wage*

Minimum Wage Rates as determined by the Commissioner of the Department of Workforce Development under the provisions of Massachusetts General Law, Chapter 149, Sections 26 to 27D, as amended, apply to this project. If the Contract duration is longer than one year, the City will obtain an updated wage schedule. Any increase or decrease in minimum wage rates will not affect the Contract Price or the unit price for any Contract items. It is the responsibility of each bidder, before bid opening, to request if necessary any additional information on Minimum Wage Rates for those trades people who may be employed for the proposed work under this Contract. The minimum wage rates to be used for this Contract are shown on the schedules provided in Section C. The Bidder's attention is also directed to Paragraph 6.02.F of the General Conditions. Federal Minimum Wage Rates as determined by the United States Department of Labor under the Davis-Bacon Act also apply to this project.

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

7. *Bidder Prerequisites*

Only Bidders who can comply with the following should submit bids as only such Bidders will be considered qualified:

- a. The bidder shall have been in the business of providing the product(s) and or service(s) for which it is submitting prices herein, for a period of no less than [ten (10)] consecutive years prior to the bid opening date.
- b. The bidder shall have provided such services or goods of the size and scope similar to that described herein to municipal customers within the last [two (2) years]. [
- c. Bidder shall include its bid a list of references for previous contracts requiring the services or goods of the type described herein, including a brief description of the services or goods provided and contact information. A "Bidder Reference Form" is

included for the Bidder's convenience in Section D (Bid Package). The City reserves the right to solicit references from customers not listed by bidder.]

8. Enclosures

A checklist of bid enclosures is provided in Section D, entitled "Bid Package." This checklist is provided as a working document for the convenience of bidders only. It is the bidder's responsibility to read the IFB fully to confirm that it has enclosed all requirements.

9. Signatures

All Bids shall be signed by a person having legal authority to bind the Bidder to the terms and conditions of the Bid, and the person so signing the Bid shall give the person's own name, business address and title. **Bids not properly signed will be rejected as non-responsive.**

All Bids shall be prepared and signed by hand in ink in the proper places provided on the bid form as follows:

- a. If the bidder is an individual, by her/him personally
- b. If the bidder is a partnership, by the name of the partnership, followed by the signature of each general partner; and
- c. If the bidder is a corporation, by the authorized officer, whose signature must be attested to by the Clerk/Secretary of the corporation and the corporate seal affixed.

10. Reservations

The City reserves the right to reject in whole or in part, any and all Bids to waive minor deviations, to cancel the IFB at any time prior to award, and/or to advertise for new Bids if funds are not available for the project or if any of those actions are in the best interest of the City.

11. Rejection of Bids

Bids which are incomplete, conditional or obscure, or which contain any additions not called for, or which otherwise do not conform to the requirements of the applicable statutes or to the requirements for submission set forth herein will be rejected as non-responsive. Bids which contain erasures, alterations or irregularities of any kind or which fail to fully meet the requirements for bid submission set forth herein, or which contain abnormally high or abnormally low prices for any item of work may be rejected as non-responsive.

More than one bid from the same bidder, whether or not the same or different names appear on the signature page, will not be considered. Reasonable grounds for believing that any

bidder is so interested in more than one bid for the work contemplated may cause rejection of all bids made by that bidder directly or indirectly.

Any or all bids potentially affected by collusion will be rejected if there is reason for believing that collusion exists among the bidders. The decision of the City will be final. Bidders whose bids have been rejected because of evidence of collusion will not be considered in future bids for the same work and may be disqualified from bidding on future work.

The City shall reject any Bid that does not include the signed Non-Collusion and Attestation Forms provided in the Bid Package.

12. Examination of Bid Documents and Site of Work

Before submitting the bid, the Bidder shall become familiar with the Bid Documents that will form parts of the Contract, shall have investigated in detail the locations of work and shall have made such examination thereof as may be necessary to satisfy itself in regard to the character of the work involved and all conditions affecting the work to be done and labor and materials needed, including impact on other City work, and make the Bid in sole reliance thereon. Statements as to the condition under which work is to be performed are made solely to furnish a basis for comparison of Bids, and while the City believes them to be correct, the City does not guarantee their accuracy. The Bidder is responsible for verifying visible and reasonably anticipated conditions. Bid documents can be downloaded electronically through the City of Framingham Department of Public Works Vendor Registry portal <https://vrapp.vendorregistry.com/Bids/View/BidsList?BuyerId=75c3b765-3725-4b32-9689-fc820e50b9c8>

13. Rule for Award

[One Contract will be awarded to the responsive and eligible bidder offering the lowest Total Estimated Contract Price for Bid Evaluation Purposes] subject to the reservations contained herein and to the exceptions set forth in MGL Chapter 30 or Chapter 149, whichever is applicable, within ninety (90) calendar days after the bid opening.

The time for award may be extended by mutual agreement between the City and the apparent lowest responsive and responsible Bidder, during which time there will be no increase in the Bid price or Contract period.

The successful bidder will within ten (10) calendar days of the notification of contract award by the City, execute a contract in accordance with the terms and conditions of this bid and furnish insurance certificates, contract bonds, and, if applicable, certification from the state secretary as required herein.

The date Contract Times will commence to run shall be communicated to the successful bidder by the City's written Notice to Proceed.

14. Interpretation of Estimated Quantities

Unless otherwise stated, quantities shown in the Specifications and Price Sheets represent the estimated quantities of labor and materials which might be expected to be encountered during the contract period. In the event of a discrepancy between the estimated quantities shown in the Specifications and those shown in the Price Sheets, quantities shown in the Price Sheets shall control. The City does not expressly or by implication agree that the actual amount of work will correspond therewith. These estimated quantities will be used solely for the comparison of bids.

The City reserves the right to increase, decrease, or delete the amount of any or all items of work after bids have been received. Such increase, decrease or deletion in the quantity for any item shall not be regarded as cause for an increase or decrease in the unit prices.

No allowance will be made for any increased expense, loss of expected reimbursement, or loss of anticipated profits suffered or claimed by the Contractor resulting either directly or indirectly from such increased, decreased, or deleted quantities or from unbalanced allocation among the Contract items or overhead expenses on the part of the bidder and subsequent loss of expected reimbursement therefore or from any other cause.

15. Failure to Furnish Bonds and Insurance Certificates

Should the successful bidder fail to perform its agreement to furnish the required bonds and insurance certificates required herein, the Bid Deposit shall become and be the property of the City as liquidated damages; provided that, the amount of the Bid Deposit which becomes the property of the City shall not, in any event, exceed the difference between its bid price and the bid price of the next lowest responsible and eligible bidder.

15.01 Certification of Foreign Corporation

If the successful bidder is a foreign corporation as defined at G.L. c. 156D, § 1.40, and if successful bidder fails to perform its agreement to furnish the required certificate of the state secretary, the Bid Deposit shall become and be the property of the City as liquidated damages; provided that, the amount of the Bid Deposit which becomes the property of the City shall not, in any event, exceed the difference between its bid price and the bid price of the next lowest responsible and eligible bidder.

16. Massachusetts Sales and Use Tax

Bidders are advised that the City is exempt from Sales and Use Tax and shall submit its bid prices without taxes. An Exemption Certificate may be obtained by the Successful Bidder from the City upon request.

17. Project Description

The purpose of this Project is to provide Worcester Road Sewer Pump Station Replacement located at 730 Worcester Road, Framingham MA 01702. Proposed work to include replacing the existing Worcester Road Sewer Pumping Station and the adjacent sewer system components and requires all work necessary or proper for or incidental to this purpose including providing all necessary supervisors, personnel, equipment, and materials. Locations of the work include the areas shown on the Contract Drawings]

18. Minority and Women Workforce Participation

The successful bidder shall comply with the Minority and Women Workforce Participation goals of 4.2% for minorities and 4.5% for women as outlined in the Commonwealth of Massachusetts Supplemental Equal Opportunity, Non-Discrimination and Affirmative Action Program. Additionally, the successful bidder shall comply with the requirements of the Environmental Protection Agency's Disadvantaged Business Enterprise (DBE) Program. The bidder shall submit completed MBE/WBE forms (EEO-DEP-190 & EEO-DEP-191, and DBE Certification as prepared by each certified DBE) and Vendor Information Forms (VIF) with the bid. 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.

The fair share goals for disadvantaged business enterprise (DBE) participation for this contract are a minimum of 4 percent Disadvantaged Minority Business Enterprise (D/MBE) participation and percent Disadvantaged Women Business Enterprise (D/WBE) participation, applicable to the total dollar amount paid for the construction contract. The Contractor shall take all affirmative steps necessary to achieve this goal and shall provide reports documenting the portion of contract and subcontract dollars paid to DBEs, and its efforts to achieve the goals, with each invoice submitted or at such greater intervals as specified by the (municipality). The contractor shall require similar reports from its subcontractor

19. Laws and Regulations

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.

20. Contractor's Guarantee

Bidders' attention is drawn to Paragraph 6.18 of the General Conditions regarding guarantee of the Work.

21. Health and Safety

This Contract 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 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.). Bidders shall be familiar with the requirements of these regulations.

22. Equipment Manufacturer Experience

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.

23. Permits and Approvals

The successful bidder will be solely responsible for obtaining all necessary construction permits, licenses, and approvals required in connection with the Project and/or under the Contract Documents, including without limitation as set forth in Paragraphs 4.01 and 6.08 of the General Conditions. The City has included the following documents as [Appendix C and Appendix H] solely to furnish a basis for comparison of Bids, and the City makes no representation or guarantee of their relevancy. All bidders shall be responsible for investigating in detail the permitting requirements of the work and shall be responsible for making such examination thereof as may be necessary to satisfy themselves in regard to the character of the permitting required, and shall Bid in sole reliance upon their own investigation.

24. Diesel Retrofit Program

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

25. Monthly Price Adjustment for Diesel Fuel, Gasoline, Asphalt, Concrete, and Steel

Monthly price adjustments will be made for qualifying work orders using Diesel Fuel, Gasoline, Asphalt, Concrete, and Steel in accordance with the Specifications. This project is subject to the American Iron and Steel requirements of P.L. 113-76, the Consolidated Appropriations Act of 2014.

26. City Forms

The City will use its standard form Notice to Proceed, Certificate of Substantial Completion, and General release. Current examples of these forms are attached to this Section as Example 1, 2, and 3.

Example 1 - Notice to Proceed

To: _____
(Contractor)

Date: _____

Agreement: _____
(Insert title of Agreement as it appears in Contract Documents)

You are hereby notified that the Effective Date of the above Agreement is _____; you are to start performing your obligations under the Agreement by that date. The Contract Times shall commence to run on _____; you must commence Work by that date. Before you may start Work, you must satisfy all requirements set forth in Article 2 of the General Conditions.

(Owner)

(Engineer)

By: Eric V Johnson, P.E.

By: _____

Title: City Engineer

Title: _____

Department of Public Works

Contractor hereby acknowledges receipt of the above Notice to Proceed, this the _____ day of _____, 2022.

By: _____

Title: _____

Example 2 - Substantial Completion

**ENGINEER'S CERTIFICATE OF
SUBSTANTIAL COMPLETION**

**ENGINEER
CONTRACTOR**

PROJECT:
(Name and Address)

PROJECT NO.:

**CONTRACT FOR:
CONTRACT DATE:**

TO OWNER: City of Framingham
Department of Public Works
100 Western Ave., Framingham, MA 01702

TO CONTRACTOR:
(Name and Address)

**DATE OF ISSUANCE:
PROJECT OR DESIGNATION PORTION SHALL INCLUDE:**

The Work performed under this Contract has been reviewed and found, to the Engineer's best knowledge, information and belief, to be substantially complete. Substantial Completion means that the Work has been completed except for Work having a contract price of less than one percent of the then adjusted total Contract Price, or substantially of the Work has been completed and opened to public use except for minor incomplete or unsatisfactory Work items that do not materially impair the usefulness of the Work. The date of Substantial Completion of the Project or portion thereof designated above is hereby established.

The Owner will send Contractor a list of items to be completed or corrected within 15 days of the date of Substantial Completion and a Substantial Completion Estimate within 65 days of the date of Substantial Completion. The failure to include any items on such list does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract Documents.

ENGINEER/ARCHITECT _____ BY _____ DATE _____

The Owner accepts the Work or designated portion thereof as substantially complete and will assume full possession thereof at _____ on _____.
(time) (date)

PROJECT MANAGER _____ BY _____ DATE _____

OWNER _____ BY _____ DATE _____

The responsibilities of the Owner and Contractor for security, maintenance, heat, utilities, damage to the Work and insurance shall be as provided in the Contract Documents, subject to such additional provisions or clarification as follows:

Example 3 - General Release

GENERAL RELEASE

For good and valuable consideration, the receipt and sufficiency of which is hereby acknowledged, _____ (hereinafter the RELEASOR), does hereby remise, release and forever discharge the City of Framingham (hereinafter "RELEASED PARTY"), its principals, agents, trustees, managing members, officers, directors, employees, representatives, affiliates, subsidiaries, parent companies, successors, assigns, insurers, reinsurers, consultants, attorneys, and all other persons, firms, corporations with whom/which said RELEASED PARTY has been, is now or may hereafter be affiliated, and all other persons, firms, entities or corporations who are or can ever, in any way, be liable to them from all debts, demands, actions, causes of action, suits, dues, sum and sums of money, accounts, reckonings, bonds, specialties, covenants, contracts, insurance policies, controversies, agreements, promises, doings, omissions, variances, damages, extents, executions and liabilities and any and all other claims of every kind, nature and description whatsoever, in both LAW and EQUITY, that the RELEASOR now have or ever had, from the beginning of the world to the date of execution herein, whether known or unknown, including but not limited to any and all claims arising out of the project known as the _____ ("Project") in Framingham, Massachusetts, and any and all claims for additional compensation that comprise all Change Orders to the Contract for the Project, and any and all related claims that were asserted or could have been asserted.

RELEASOR further acknowledge that this Release may be offered in evidence by any of the RELEASED PARTY in judicial or other proceedings to enforce any of its provisions against said RELEASOR, their heirs, executors, administrators, assigns, legal representatives, estates and successors or for any other purpose.

It is expressly understood and agreed by the RELEASOR and the RELEASED PARTY that this Release reflects the settlement of a disputed claim and is not to be construed as an admission of liability on the part of said RELEASED PARTY and that said RELEASED PARTY expressly denies any liability for any injury or damage of any kind or nature to _____.

No promise or inducement which is not herein expressed has been made to the RELEASOR in executing this Release. The RELEASOR does not rely upon any statement or representation made or alleged to have been made by or on behalf of any of the RELEASED PARTY or any agent, servant, employee, attorney, insurer or any other person representing the RELEASED PARTY concerning the nature, extent or duration of said damages or losses or the legal liabilities therefore.

The RELEASOR hereby understands and acknowledges that this RELEASE contains the entire agreement between the parties hereto, and the terms of this RELEASE are contractual and not a mere recital.

The RELEASOR hereby represents that it has read and understands the terms of this RELEASE, had the opportunity to consult with an attorney of its choice prior to the execution of this RELEASE, and did in fact consult with such an attorney prior to execution of this RELEASE.

The RELEASOR further represents that the person executing this RELEASE on behalf of the RELEASOR has the requisite authorizations and approvals of the RELEASOR necessary to bind the RELEASOR to the terms hereto.

This RELEASE is and always will be deemed to have been made in the Commonwealth of Massachusetts.

Executed as a sealed instrument this _____ day of _____, 20__.

By:
Its: _____ duly authorized
Date: _____, 20__

Commonwealth of Massachusetts

_____, ss.

Date: _____

On this _____ day of _____, 20__, before me, the undersigned notary public, personally appeared _____ and proved to me through satisfactory evidence of identification, which was _____, to be the person whose name is signed on the within document, and acknowledged that he/she signed it as his/her free act and deed, in his/her capacity as _____, and on behalf of _____.

Notary Public
My Commission Expires:

SECTION B: SHORT FORM OF AGREEMENT

The awarded bidder will be expected to enter into an Agreement with the City by executing the attached Short Form of Agreement (“Contract”).

This Contract contains terms and conditions which the Bidder agrees to by submission of its bid.

Do not complete or return this form with the bid.

THE REMAINDER OF THIS PAGE IS LEFT BLANK INTENTIONALLY

**SHORT FORM OF AGREEMENT FOR CONSTRUCTION
BETWEEN CITY AND CONTRACTOR PROCURED UNDER G.L. C. 30, §39M**

THIS AGREEMENT for **PW-1025 Worcester Road Sewer Pump Station Replacement** (hereinafter referred to as the "Project"), is made the _____ day of _____, 2022, by and between _____, a corporation duly organized under the laws of the Commonwealth of Massachusetts, with a usual place of business at _____, (hereinafter referred to as the "CONTRACTOR"), and the City of Framingham, a municipal corporation duly organized under the laws of the Commonwealth of Massachusetts, (hereinafter referred to as the "CITY").

WITNESSETH that the CONTRACTOR and the City, for the consideration hereinafter named, agree as follows:

ARTICLE 1: CONTRACT DOCUMENTS

The Contract Documents consist of the following, and in the event of conflicts or discrepancies among them, they shall be interpreted on the basis of the following priorities and in the manner most favorable to the City:

- (1) This Short Form of Agreement for Procurement between City and CONTRACTOR
- (2) General Conditions of the Construction Contract, as modified by the Supplementary Conditions
- (3) Specifications
- (4) Invitation for bids, bid specifications, request for proposals or purchase description
- (5) Drawings required for the project
- (6) Performance bond in the form attached hereto as **Exhibit A**
- (7) Payment bond in the form attached hereto as **Exhibit B**
- (8) Addenda issued prior to execution of the Agreement
- (9) CONTRACTOR's bid or proposal
- (10) Modifications issued after execution of the Agreement, which are not attached hereto, including the following:
 - a. Work Order issued by the City
 - b. Written amendment to the Agreement signed by both parties
 - c. Change Order
- (11) Copies of all required bonds, certificates of insurance and licenses required under the Agreement,
- (12) Notice to Proceed, which may be delivered or issued on or after the Effective Date of this Agreement and may not be attached hereto
- (13) The Summary of Conflict of Interest Law for Municipal Employees attached hereto as **Exhibit C**, as well as the acknowledgement of receipt of summary attached hereto as **Exhibit D** and confirmation of completion of online training, and
- (14) Affirmative Action & Equal Employment Opportunity Requirements attached hereto as **Exhibit E**

EACH OF WHICH IS ATTACHED HERETO except as otherwise provided. These documents form the entire Agreement between the parties and there are no other agreements between the parties. Any amendment or modification to this Agreement must be in writing and signed by an official with the authority to bind the City. Such amendment or modification shall be incorporated into and made part of this Agreement.

ARTICLE 2: SCOPE OF WORK

The CONTRACTOR shall furnish all materials, labor and equipment, and perform all work shown on the Contract Documents, and the CONTRACTOR agrees to do everything required by this Agreement and the Contract Documents.

ARTICLE 3: TERM OF AGREEMENT

- (a) All time limits for Milestones, if any, Substantial Completion, and completion and readiness for final payment as stated in the Contract Documents are of the essence of the Agreement.
- (b) The Work will be substantially completed within **898 calendar days** after the date when the Contract Times commence to run as provided in Paragraph 2.01 of the General Conditions, and completed and ready for final payment within **928 calendar days** after the date when the Contract Times commence to run.
- (c) If the CONTRACTOR fails to substantially or finally complete the work or achieve any Milestone by the date specified in the Contract Documents, or an extended completion date which is mutually agreed upon by the CITY and the CONTRACTOR, the CONTRACTOR shall pay to the CITY not as a penalty but as liquidated damages the sum of **Two Thousand Five Hundred dollars (\$2500.00)** per day for each and every calendar day beyond the date on which completion was required. This amount is fixed and agreed upon by and between the CITY and CONTRACTOR to be the amount of damages which the CITY would sustain, and is based upon the parties' agreed upon reasonable estimate of those actual damages likely to result from the CONTRACTOR's breach hereunder. The CITY's right to assess liquidated damages shall not preclude the CITY from the exercise of any other rights to recover damages on account of the CONTRACTOR's failure to achieve substantial or final completion within the time required.

ARTICLE 4: THE CONTRACT SUM

1. The CONTRACTOR agrees to provide to the CITY items at the specific price points listed in the CONTRACTOR'S bid submission, for the duration of the contract. The CITY makes no guarantee to purchase any minimum or specific quantity of goods or services under the

provisions of this contract. The total value of the goods and services will not exceed the sum of **\$XXXXXXXX.XX** (xxxxxxxxxxxxxxxx and no cents) without the issuance of a change order agreed to in writing by all parties.

2. The Unit Prices, if any, approved by the City are those included in the Contractor's bid or proposal.

ARTICLE 5: PAYMENT

- (a) CONTRACTOR shall submit Applications for Payment in accordance with Paragraph 14.02 of the General Conditions. Applications for Payment will be processed by Engineer as provided in the General Conditions.
- (b) Prior to Substantial Completion, progress payments will be made in an amount equal to the percentage indicated below but, in each case, less the aggregate of payments previously made and less such amounts as Engineer may determine or Owner may withhold, including but not limited to liquidated damages, in accordance with Article 3 of this Agreement.
 - 1. 95% of Work completed (with the balance being retainage).
 - 2. 95% percent of cost of materials and equipment not incorporated in the Work but which satisfies the requirements of Paragraph 14.02.A of the General Conditions (with the balance being retainage).
- (c) Upon satisfaction of the Substantial Completion procedures set forth in Paragraph 14.04 of the General Conditions, the City shall pay an amount sufficient to increase total payments to CONTRACTOR to 99% of the Work completed, less such amounts as Engineer may determine or Owner may withhold in accordance with Article 3 of this Agreement and Paragraph 14.04 of the General Conditions.
- (d) Upon final completion and acceptance of the Work and satisfaction of the procedures set forth in Paragraph 14.06 of the General Conditions, the City shall pay the remainder of the Contract Price as recommended by Engineer as provided in Paragraph 14.07 of the General Conditions.

ARTICLE 6: CONTRACTOR'S REPRESENTATIONS

In order to induce the City to enter into this Agreement, CONTRACTOR makes the following representations:

- A. CONTRACTOR has examined and carefully studied the Contract Documents and the other related data identified in the Bidding Documents.

- B. CONTRACTOR has visited the Site and become familiar with and is satisfied as to the general, local, and Site conditions that may affect cost, progress, and performance of the Work.
- C. CONTRACTOR is familiar with and is satisfied as to all federal, state, and local Laws and Regulations that may affect cost, progress, and performance of the Work.
- D. CONTRACTOR has carefully studied all: (1) reports of explorations and tests of subsurface conditions at or contiguous to the Site and all drawings of physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities), if any, that have been identified in the Contract Documents as containing reliable “technical data”, and (2) reports and drawings of Hazardous Environmental Conditions, if any, at the Site that have been identified in the Contract Documents as containing reliable “technical data.”
- E. CONTRACTOR has considered information known to CONTRACTOR; information commonly known to CONTRACTORS doing business in the locality of the Site; information and observations obtained from visits to the Site; the Contract Documents; and the Site-related reports and drawings identified in the Contract Documents, with respect to the effect of such information, observations, and documents on (1) the cost, progress, and performance of the Work; (2) the means, methods, techniques, sequences, and procedures of construction to be employed by CONTRACTOR, including any specific means, methods, techniques, sequences, and procedures of construction expressly required by the Contract Documents; and (3) CONTRACTOR’s safety precautions and programs.
- F. Based on the information and observations referred to in Paragraphs A through E above, CONTRACTOR does not consider that further examinations, investigations, explorations, tests, studies, or data are necessary for the performance of the Work at the Contract Price, within the Contract Times, and in accordance with the other terms and conditions of the Contract Documents.
- G. CONTRACTOR is aware of the general nature of work to be performed by Owner and others at the Site that relates to the Work as indicated in the Contract Documents.
- H. CONTRACTOR has given Owner written notice of all conflicts, errors, ambiguities, or discrepancies that CONTRACTOR has discovered in the Contract Documents, and the written resolution thereof by Owner is acceptable to CONTRACTOR.
- I. The Contract Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performance and furnishing of the Work.

ARTICLE 7: TERMINATION

In addition to the provisions of Article 15 of the General Conditions, the CITY shall have the right to terminate this Agreement if funds are not appropriated or otherwise made available to support the continuation of this Agreement after the first year.

ARTICLE 8: NOTICE

All notices required to be given under this Agreement shall be in writing and shall be effective upon receipt by hand delivery or by registered or certified mail to:

City of Framingham:

Contract Administrator

Amy Putney

150 Concord Street

Framingham, MA 01702

CONTRACTOR:

Name _____

Title _____

Company _____

Address _____

Phone: _____

Fax: _____

E-Mail: _____

ARTICLE 9: PERFORMANCE AND PAYMENT BONDS

When CONTRACTOR delivers the executed counterparts of the Agreement to Owner, CONTRACTOR shall also deliver performance and payment bonds as follows, subject to the additional requirements set forth in Paragraph 5.01 of the General Conditions:

- (a) The CONTRACTOR shall furnish a **100% Performance Bond** from a surety company qualified to do business under the laws of the Commonwealth of Massachusetts which is satisfactory to the CITY in the full amount of the Contract Price and in the form attached hereto as **Exhibit A**.
- (b) The CONTRACTOR shall furnish a **100% Payment Bond** from a surety company qualified to do business under the laws of the Commonwealth of Massachusetts which is satisfactory to the CITY in the full amount of the Contract Price and in the form attached hereto as **Exhibit B**.

ARTICLE 10: INSURANCE

A. Insurance Generally.

1. The CONTRACTOR shall purchase and maintain insurance of the type and limits listed in this Article with respect to the operations as well as the completed operations of this Contract. This insurance shall be provided at the CONTRACTOR's expense and shall be in full force and effect for the full term of the Contract or for such longer period as this Article requires.

2. All policies shall be written on an occurrence basis and be issued by companies lawfully authorized to write that type of insurance under the laws of the Commonwealth with a financial strength rating of A- or better as assigned by AM Best Company, or an equivalent rating assigned by a similar rating agency acceptable to the CITY, or otherwise acceptable to the CITY.

3. CONTRACTOR shall submit three originals of each certificate of insurance, acceptable to the CITY, simultaneously with the execution of this Contract. Certificates shall show each type of insurance, insurance company, policy number, amount of insurance, deductibles and/or self-insured retentions, and policy effective and expiration dates. Certificates shall show the CITY and anyone else the CITY requests as an additional insured as to all policies of liability insurance. Certificates shall specifically note the following:

- that the General Liability policy includes contractual liability
- that the General Liability policy includes the CITY as additional insureds for ongoing operations (CG 20 10) and for completed operations (CG 20 37) or equivalent endorsements.
- that the automobile liability, umbrella liability and pollution liability policies include the CITY as additional insureds
- that the General Liability policy includes endorsement CG 24 04 or equivalent, a Waiver of Subrogation in favor of the CITY
- that the Builders' Risk or Installation Floater is on an all risk basis including earthquake and flood, and includes the CITY, CONTRACTOR, subcontractors and suppliers of any tier as named insureds or loss payees as their interests may appear.
- that the policies have been endorsed such that none of the coverages shall be cancelled, terminated, or materially modified unless and until 30 days prior notice is given in writing to the CITY.

CONTRACTOR shall submit updated certificates prior to the expiration of any of the policies referenced in the certificates so that the CITY shall at all times possess certificates indicating current coverage.

D. The CONTRACTOR shall file one certified complete copy of all policies and endorsements with the CITY within sixty days after Contract award. If the CITY is damaged by the CONTRACTOR's failure to maintain such insurance and to comply with the terms of this Article, then the CONTRACTOR shall be responsible for all costs and damages to the CITY attributable thereto.

E. Termination, cancellation, or material modification of any insurance required by this Contract, whether by the insurer or the insured, shall not be valid unless written notice thereof is given to the CITY at least thirty days prior to the effective date thereof, which shall be expressed in said notice.

F. The CONTRACTOR is responsible for the payment of any and all deductibles under all of the insurance required below. The CITY shall not in any instance be responsible for the payment of deductibles, self-insured retentions, or any portion thereof.

2. Commercial General Liability.

A. The CONTRACTOR shall purchase and maintain broad form general liability coverage on the ISO form CG 00 01 or equivalent, including products and completed operations, on an occurrence basis. The form must be amended to state that the aggregate limit applies on a per location/project basis. The policy shall provide the following minimum coverage to protect the CONTRACTOR from claims with respect to the operations performed by CONTRACTOR and any employee, subcontractor, or supplier, or by anyone for whose acts they may be liable:

Bodily Injury & Property Damage	\$1,000,000 each occurrence
Products & Completed Operations	\$2,000,000 general aggregate per project
Personal & Advertising Injury	\$2,000,000 annual aggregate
Medical Expenses	\$1,000,000 each occurrence
	\$10,000

B. This policy shall include coverage relating to explosion, collapse, and underground property damage.

C. This policy shall include contractual liability coverage.

D. The completed operations coverage shall be maintained for a period of three (3) years after Substantial Completion and acceptance by the CITY. The CONTRACTOR shall provide renewal certificates of insurance to the CITY as evidence that this coverage is being maintained.

E. If the Work includes work to be performed within 50 feet of a railroad, any exclusion for liability assumed under contract for work within 50 feet of a railroad shall be deleted.

F. This policy shall include the CITY and anyone else requested by the CITY as an additional insured via endorsements CG 20 10 for ongoing operations and CG 20 37 for completed operations. This policy shall be primary and non-contributory with respect to any other insurance available to additional insureds.

G. The policy shall include endorsement CG 24 04, a Waiver of Subrogation in favor of the CITY.

3. Automobile Liability.

A. The CONTRACTOR shall purchase and maintain the following minimum coverage with respect to the operations of any owned, non-owned, and hired vehicles including trailers used in the performance of the work:

Bodily Injury & Property Damage	\$1,000,000.00 combined single limit
---------------------------------	--------------------------------------

B. The policy shall include a CA 99 48 Broadened Pollution Endorsement. If specified in Exhibit A to the Owner – CONTRACTOR Agreement, the CONTRACTOR, if hauling contaminants and/or pollutants, must adhere to Sections 29 and 30 of the Motor Carrier Act of 1980, which shall include coverage Form MCS-90.

C. The policy shall include the CITY as an additional insured.

D. The policy shall contain a Waiver of Subrogation in favor of the CITY.

4. Contractor’s Pollution Liability.

The CONTRACTOR shall purchase and maintain coverage for bodily injury and property damage resulting from liability arising out of pollution related exposures such as asbestos abatement, lead paint abatement, tank removal, removal of contaminated soil, etc. The insurance policy shall cover the liability of the CONTRACTOR during the process of removal, storage, transport and disposal of hazardous waste and contaminated soil and/or asbestos abatement. The policy shall include coverage for on-Site and off-Site bodily injury and loss of, damage to, or loss of use of property, directly or indirectly arising out of the discharge, dispersal, release or escape of smoke, vapors, soot, fumes, acids, alkalis, toxic chemicals, liquids or gas, waste materials or other irritants, contaminants or pollutants into or upon the land, the atmosphere or any water course or body of water, whether it be gradual or sudden and accidental. The policy shall also include defense and clean-up costs. The CITY shall be named as an additional insureds and coverage must be on an occurrence basis. The amount of coverage shall be as follows:

Limit of liability \$1,000,000 per occurrence
\$3,000,000 aggregate

5. Worker's Compensation.

A. The CONTRACTOR shall provide the following coverage in accordance with M.G.L. c.149 §34A and c.152 as amended:

Worker's Compensation	Statutory limits
Employer's Liability	\$ 1,000,000 each accident
	\$ 1,000,000 disease per employee
	\$ 1,000,000 disease policy aggregate

B. If specified in Article 5 of the General Conditions, the policy must be endorsed to cover United States Longshoremen & Harborworkers Act (USLHW), or Maritime Liability.

C. The policy shall contain a Waiver of Subrogation in favor of the CITY.

6. Builder's Risk/ Installation Floater/Stored Materials.

A. The CONTRACTOR shall purchase and maintain coverage against loss or damage on all Work included in this Contract in an amount equal to the Contract Price. Such Coverage shall be written on an all risks basis or equivalent form and shall include, without limitation, insurance against perils of fire (with extended coverage) and physical loss or damage including, without duplication of coverage, theft, vandalism, malicious mischief, terrorism (“certified” and “non-certified”), collapse, earthquake, flood (if the project is not in an “A” or a “V” flood Zone), windstorm, falsework, testing and startup, temporary buildings and debris removal including demolition occasioned by enforcement of any applicable legal requirements, and shall cover reasonable compensation for Architect’s and CONTRACTOR’s services and expenses required as result of such insured loss. Unless otherwise specified in this Contract, the limits for earthquake and flood shall be the lesser of the Contract Price or \$10,000,000. This policy and /or installation floater shall include transportation and Stored Materials coverage in an amount equal to the value of the stored materials as required in C. below.

B. When Work will be completed on existing buildings owned by the Owner, the Contractor shall provide an installation floater, in the full amount of the Contract Price. Such coverage shall be written on an all risks basis or equivalent form and shall include, without limitation, insurance against perils of fire (with extended coverage) and physical loss or damage

including, without duplication of coverage, theft, vandalism, malicious mischief, collapse, earthquake, flood (if the project is not in an "A" or a "V" flood Zone), windstorm, falsework, testing and startup, temporary buildings and debris removal including demolition occasioned by enforcement of any applicable legal requirements, and shall cover reasonable compensation for Architect's and CONTRACTOR's services and expenses required as a result of such insured loss. Unless otherwise specified in this Contract, the limits for earthquake and flood shall be the lesser of the Contract Price or \$10,000,000. This policy and/or installation floater shall include transportation and Stored Materials coverage in an amount equal to the value of the stored materials as required in C. below.

C. The CONTRACTOR shall maintain insurance on delivered and/or stored material designated to be incorporated in the Work against fire, theft or other hazards. Any loss or damage of whatever nature to such material while stored at an off Site location shall be forthwith replaced by the CONTRACTOR at no expense to the CITY.

D. The policy or policies shall specifically state that they are for the benefit of and payable to the CITY, the CONTRACTOR, and all persons furnishing labor or labor and materials for the Contract Work, as their interests may appear. The policy or policies shall list the CITY, the CONTRACTOR, and Subcontractors of any tier as named insureds.

E. Coverage shall include any costs for work performed by the Designer or any consultant as the result of a loss experienced during the term of this Contract.

F. Coverage shall include permission for temporary occupancy and a Waiver of Subrogation in favor of the CITY.

G. Coverage shall be maintained until final acceptance by the CITY of the Contract and final payment has been made.

H. A loss under the property insurance shall be adjusted by the CONTRACTOR as fiduciary and made payable to the CONTRACTOR as fiduciary for the insureds. The CONTRACTOR shall pay the subcontractors their just shares of insurance proceeds received by the CONTRACTOR and shall require subcontractors to make payments to their sub-subcontractors in similar manner.

7. Umbrella Coverage.

The CONTRACTOR shall provide Umbrella Coverage in a form at least as broad as primary coverages required by Sections 2, 3 and 5 of this Article in the following amount:

<u>Contract Price:</u>	<u>Limit of Liability:</u>
Under \$150,000	\$1,000,000 per occurrence
\$150,000 -- \$1,000,000	\$2,000,000 per occurrence
\$1,000,001 -- \$5,000,000	\$5,000,000 per occurrence
\$5,000,001-- \$10,000,000	\$10,000,000 per occurrence
\$10,000,001 and over	\$25,000,000 per occurrence

8. Additional Types of Insurance.

The CONTRACTOR shall provide such other types of insurance as may be required by Article 5 of the General Conditions.

ARTICLE 11: INDEMNIFICATION

- A. To the fullest extent permitted by Laws and Regulations, CONTRACTOR shall indemnify, defend, and hold harmless Owner and Engineer and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or other dispute resolution costs) for or on account of or relating to any act, omission, or negligence of the CONTRACTOR, Subcontractors, or its or their agents or employees in the performance of the Work and/or their failure to comply with the terms and conditions of this Agreement. The foregoing provision shall not be deemed to be released, waived, or modified in any respect by reason of any surety or insurance provided by CONTRACTOR.
- B. In any and all claims against Owner or Engineer or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors by any employee (or the survivor or personal representative of such employee) of CONTRACTOR, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, the indemnification obligation under this Agreement shall not be limited in any way by any limitation on the amount or type of damages, compensation, or benefits payable by or for CONTRACTOR or any such Subcontractor, Supplier, or other individual or entity under workers' compensation acts, disability benefit acts, or other employee benefit acts.

ARTICLE 12: MANDATORY ETHICS TRAINING

A summary of the Conflict of Interest Law is attached hereto as **Exhibit C** and must be distributed to all key employees of the Contractor pursuant to G.L. c. 268A. Questions regarding whether any of the Contractor's employees are considered "key employees" should be directed to the Legal Division of the State Ethics Commission at (617) 371-9500. Pursuant to Chapter 28 of the Acts of 2009, as amended, all key employees must complete online ethics training on the State Ethics Commission's website, www.mass.gov/ethics. Within thirty days of the date of this Agreement, each key employee must provide to the City a signed acknowledgment of receipt of the summary of the Conflict of Interest Law, in the form attached hereto as **Exhibit D**, and a certificate of completion of the online training which must be printed at the completion of the training. In the event that the term of this Agreement extends for more than two years, all continuously employed key employees shall repeat the online training and provide the City with a new certificate of completion within ninety days before or ninety days after the two-year anniversary of the date of this Agreement. Any new key employee who becomes employed by the Contractor after the date of this Agreement and whose services are specifically required by this Agreement must complete the online training and provide the City with a certificate of

completion within thirty days of the date on which his services commence pursuant to this Agreement. Satisfaction of these requirements is the sole responsibility of the Contractor and its key employees, and the City shall have no liability for the Contractor's or its key employees' failure to meet these requirements.

ARTICLE 13: AFFIRMATIVE ACTION AND EQUAL EMPLOYMENT OPPORTUNITY

CONTRACTOR shall comply with the requirements of G.L. c. 151 governing non-discrimination in employment; City of Framingham General Bylaws Article I, Section 4; and the Affirmative Action & Equal Employment Opportunity Requirements attached hereto as **Exhibit E**.

ARTICLE 14: MISCELLANEOUS

- A. This Agreement shall be binding upon the CITY and the CONTRACTOR and the partners, successors, heirs, executors, administrators, assigns and legal representatives of the CITY and the CONTRACTOR. Neither the CITY nor the CONTRACTOR shall assign, sublet or transfer any interest in this Agreement without the written consent of each other, and such consent shall not be unreasonably withheld.
- B. Terms used in this Agreement will have the meanings stated in the General Conditions and the Supplementary Conditions.
- C. Any provision or part of the Contract Documents held to be void or unenforceable under any Law or Regulation shall be deemed stricken, and all remaining provisions shall continue to be valid and binding upon CITY and CONTRACTOR, who agree that the Contract Documents shall be reformed to replace such stricken provision or part thereof with a valid and enforceable provision that comes as close as possible to expressing the intention of the stricken provision.
- D. The contractor shall not participate in or cooperate with an international boycott, as defined in Section 999(b)(3) and (4) of Internal Revenue code 1986 as amended, or engage in conduct declared to be unlawful by Section 2 of Chapter 151E of the Massachusetts General Laws.

IN WITNESS WHEREOF the parties hereto have executed copies of this Agreement the day and year first above written. *

*If a Corporation, attach to each signed copy of this Contract an attested copy of the vote of the Corporation on authorizing the said signing and sealing.

CONTRACTOR: _____

BY: _____

Title: _____

Dated: _____

Corporate Seal:

Robert A. Lewis,

Director

Department of Public Works

Dated: _____

Approved as To Form

Jennifer A. Pratt
Chief Procurement Officer

Dated: _____

Kathryn M. Fallon
City Solicitor

Dated: _____

Approved as to Funds Availability
Pursuant to M.G.L. c. 44, §31C, I certify that an appropriation has been made in the total amount of the contract.

Richard G. Howarth
City Accountant

Dated: _____

Michael Tusino
Chief Operating Officer

Funding Source:

Requisition Number: _____

Org: _____ Obj: _____ Project: _____

Procurement Source:

Bid #PW-1025

Exhibit A - Performance Bond

Bond No. _____

KNOW ALL MEN BY THESE PRESENT, that we _____ with a place of business at _____ as principal (the "Principal"), and _____, a corporation qualified to do business in the Commonwealth of Massachusetts, with a place of business at _____ as Surety (the "Surety"), are held and firmly bound unto the City of Framingham as Obligee (the "Obligee"), in the sum of _____ lawful money of the United States of America, to be paid to the Obligee, for which payment, well and truly to be made, we bind ourselves, our respective heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these present.

WHEREAS, the Principal has assumed and made a contract with the Obligee, bearing the date of _____, for the [PW-XXX Worcester Road Sewer Pump Station Replacement Project.]

NOW THE CONDITIONS of this obligation are such that if the Principal and all Subcontractors under said contract shall well and truly keep and perform all the undertakings, covenants, agreement, terms, and conditions of said contract on its part to be kept and performed during the original term of said contract and any extensions thereof that may be granted by the Obligee, with or without notice to the Surety, and during the life and any guarantee required under the contract, and shall also well and truly keep and perform all the undertakings, covenants, agreements, terms and conditions of any and all duly authorized modifications, alterations, changes or additions being hereby waived, then this obligation shall become null and void; otherwise, it shall remain in full force and virtue.

IN THE EVENT the Contract is abandoned by the Principal, or is terminated by the City of Framingham under the applicable provisions of the Contract, the Surety hereby further agrees that the Surety shall, if requested in writing by the City of Framingham promptly take such action as is necessary to complete said Contract in accordance with its terms and conditions.

IN WITNESS WHEREOF, the Principal and Surety have hereto set their hands and seals this _____ day of _____, [2022].

PRINCIPAL

SURETY

[Name and Seal]

[Attorney-In-Fact]

[Title]

[Address]

[Phone]

Attest: _____

Attest: _____

The rate of the Bond is _____% of the first \$ _____ and _____% for the next \$ _____.

The total premium for this Bond is \$ _____.

END OF PERFORMANCE BOND

Exhibit B - Payment Bond

Bond No. _____

KNOW ALL MEN BY THESE PRESENT, that we _____ with a place of business at _____ as principal (the "Principal"), and _____, a corporation qualified to do business in the Commonwealth of Massachusetts, with a place of business at _____ as Surety (the "Surety"), are held and firmly bound unto City of Framingham as Obligee (the "Obligee"), in the sum of _____ lawful money of the United States of America, to be paid to the Obligee, for which payment, well and truly to be made, we bind ourselves, our respective heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these present.

WHEREAS, the Principal has assumed and made a contract with the Obligee, bearing the date of _____ - _____, for the **[PW-XXX Worcester Road Sewer Pump Station Replacement Project]**.

NOW, THE CONDITIONS of this obligation are such that if the Principal and all subcontractors under said contract shall pay for all labor performed or furnished and for all materials used or employed in said contract and in any and all duly authorized modifications, alterations, extensions of time, changes or additions to said contract that may hereafter be made, notice to the Surety of such modifications, alterations, extensions of time, changes or additions being hereby waived, the foregoing to include any other purposes or items set out in, and to be subject to, the provisions of Massachusetts General Laws, Chapter 30, Section 39A, and Chapter 149, Section 29, as amended then this obligation shall become null and void; otherwise, it shall remain in full force and virtue.

IN WITNESS WHEREFORE, the Principal and Surety have hereto set their hands and seals this _____ day of _____, [2022].

PRINCIPAL

SURETY

[Name and Seal]

[Attorney-In-Fact][Seal]

[Title]

[Address]

[Phone]

Attest: _____

Attest: _____

The rate for this Bond is _____% of the first \$_____ and _____% for the next \$_____.

The total premium for this Bond is \$_____.

END OF PAYMENT BOND

Exhibit C - Summary of The Conflict Of Interest Law

Mandatory Training Requirements - Summaries and Online Training

Mandatory educational requirements under the Ethics Reform Bill

Summary of the Conflict of Interest Law for Municipal Employees

By December 28, 2009, and on an annual basis thereafter, all current municipal employees must be provided with this summary of the conflict of interest law. Municipal employees hired after December 28, 2009, should be provided with the summary within 30 days of the date on which they commence employment, and on an annual basis thereafter. Every municipal employee is required to sign a written acknowledgment that he has been provided with the summary.

Online Training Program

www.mass.gov/ethics - Under Education & Training Resources

By 12/28/09, and every 2 years thereafter, all current state, county and municipal employees must complete this training. Public employees hired after 12/28/09 must complete this training within 30 days of beginning public service, and every 2 years thereafter. This training is designed primarily for state employees. County and municipal employees should also use this training until it is revised with one tailored to them. Upon completing the program, employees should print out the completion certificate and keep a copy for themselves. Employees will be required to provide a copy of the completion certificate to the Town or City Clerk (municipal employees), their employing agency (appointed state and county employees), or to the Ethics Commission (elected state and county employees). Completing the single program will be considered by the Commission as meeting the Bill's training requirements until a second program is added. When multiple users attempt to complete the current training program using the same computer they may experience a problem accessing the beginning of the program. The user will need to open their internet browser, click on "Tools", then "Internet Options", select "Delete Cookies", then click "OK". The user will be able to click back on the Online Training module on the Commission's website and start at the beginning.

After you have completed the Online Training, print out the “State Ethics Commission Receipt”, and return with the receipt entitled “Conflict of Interest Law”.

Summary of the Conflict of Interest Law for Municipal Employees

This summary of the conflict of interest law, General Laws chapter 268A, is intended to help municipal employees understand how that law applies to them. This summary is not a substitute for legal advice, nor does it mention every aspect of the law that may apply in a particular situation. Municipal employees can obtain free confidential advice about the conflict of interest law from the Commission's Legal Division at our website, phone number, and address above. Municipal counsel may also provide advice.

The conflict of interest law seeks to prevent conflicts between private interests and public duties, foster integrity in public service, and promote the public's trust and confidence in that service by placing restrictions on what municipal employees may do on the job, after hours, and after leaving public service, as described below. The sections referenced below are sections of G.L. c. 268A.

When the Commission determines that the conflict of interest law has been violated, it can impose a civil penalty of up to \$10,000 (\$25,000 for bribery cases) for each violation. In addition, the Commission can order the violator to repay any economic advantage he gained by the violation, and to make restitution to injured third parties. Violations of the conflict of interest law can also be prosecuted criminally.

I. Are you a municipal employee for conflict of interest law purposes?

You do not have to be a full-time, paid municipal employee to be considered a municipal employee for conflict of interest purposes. Anyone performing services for a city or town or holding a municipal position, whether paid or unpaid, including full- and part-time municipal employees, elected officials, volunteers, and consultants, is a municipal employee under the conflict of interest law. An employee of a private firm can also be a municipal employee, if the private firm has a contract with the city or town and the employee is a "key employee" under the contract, meaning the town has specifically contracted for her services. The law also covers private parties who engage in impermissible dealings with municipal employees, such as offering bribes or illegal gifts.

II. On-the-job restrictions.

(a) **Bribes. Asking for and taking bribes is prohibited. (See Section 2)**

A bribe is anything of value corruptly received by a municipal employee in exchange for the employee being influenced in his official actions. Giving, offering, receiving, or asking for a bribe is illegal.

Bribes are more serious than illegal gifts because they involve corrupt intent. In other words, the municipal employee intends to sell his office by agreeing to do or not do some official act, and the giver intends to influence him to do so. Bribes of any value are illegal.

(b) Gifts and gratuities. Asking for or accepting a gift because of your official position, or because of something you can do or have done in your official position, is prohibited. (See Sections 3, 23(b)(2), and 26)

Municipal employees may not accept gifts and gratuities valued at \$50 or more given to influence their official actions or because of their official position. Accepting a gift intended to reward past official action or to bring about future official action is illegal, as is giving such gifts. Accepting a gift given to you because of the municipal position you hold is also illegal. Meals, entertainment event tickets, golf, gift baskets, and payment of travel expenses can all be illegal gifts if given in connection with official action or position, as can anything worth \$50 or more. A number of smaller gifts together worth \$50 or more may also violate these sections.

Example of violation: A town administrator accepts reduced rental payments from developers.

Example of violation: A developer offers a ski trip to a school district employee who oversees the developer's work for the school district.

Regulatory exemptions. There are situations in which a municipal employee's receipt of a gift does not present a genuine risk of a conflict of interest, and may in fact advance the public interest. The Commission has created exemptions permitting giving and receiving gifts in these situations. One commonly used exemption permits municipal employees to accept payment of travel-related expenses when doing so advances a public purpose. Another commonly used exemption permits municipal employees to accept payment of costs involved in attendance at educational and training programs. Other exemptions are listed on the Commission's website.

Example where there is no violation: A fire truck manufacturer offers to pay the travel expenses of a fire chief to a trade show where the chief can examine various kinds of fire-fighting equipment that the town may purchase. The chief fills out a disclosure form and obtains prior approval from his appointing authority.

Example where there is no violation: A town treasurer attends a two-day annual school featuring multiple substantive seminars on issues relevant to treasurers. The annual school is paid for in part by banks that do business with town treasurers. The treasurer is only required to make a disclosure if one of the sponsoring banks has official business before her in the six months before or after the annual school.

(c) Misuse of position. Using your official position to get something you are not entitled to, or to get someone else something they are not entitled to, is prohibited. Causing someone else to do these things is also prohibited. (See Sections 23(b)(2) and 26)

A municipal employee may not use her official position to get something worth \$50 or more that would not be properly available to other similarly situated individuals. Similarly, a municipal employee may not use her official position to get something worth \$50 or more for someone else that would not be properly available to other similarly situated individuals. Causing someone else to do these things is also prohibited.

Example of violation: A full-time town employee writes a novel on work time, using her office computer, and directing her secretary to proofread the draft.

Example of violation: A city councilor directs subordinates to drive the councilor's wife to and from the grocery store.

Example of violation: A mayor avoids a speeding ticket by asking the police officer who stops him, "Do you know who I am?" and showing his municipal I.D.

(d) Self-dealing and nepotism. Participating as a municipal employee in a matter in which you, your immediate family, your business organization, or your future employer has a financial interest is prohibited. (See Section 19)

A municipal employee may not participate in any particular matter in which he or a member of his immediate family (parents, children, siblings, spouse, and spouse's parents, children, and siblings) has a financial interest. He also may not participate in any particular matter in which a prospective employer, or a business organization of which he is a director, officer, trustee, or employee has a financial interest. Participation includes discussing as well as voting on a matter, and delegating a matter to someone else.

A financial interest may create a conflict of interest whether it is large or small, and positive or negative. In other words, it does not matter if a lot of money is involved or only a little. It also does not matter if you are putting money into your pocket or taking it out. If you, your immediate family, your business, or your employer have or has a financial interest in a matter, you may not participate. The financial interest must be direct and immediate or reasonably foreseeable to create a conflict. Financial interests which are remote, speculative or not sufficiently identifiable do not create conflicts.

Example of violation: A school committee member's wife is a teacher in the town's public schools. The school committee member votes on the budget line item for teachers' salaries.

Example of violation: A member of a town affordable housing committee is also the director of a non-profit housing development corporation. The non-profit makes an application to the committee, and the member/director participates in the discussion.

Example: A planning board member lives next door to property where a developer plans to construct a new building. Because the planning board member owns abutting property, he is presumed to have a financial interest in the matter. He cannot participate unless he provides the State Ethics Commission with an opinion from a qualified independent appraiser that the new construction will not affect his financial interest.

In many cases, where not otherwise required to participate, a municipal employee may comply with the law by simply not participating in the particular matter in which she has a financial interest. She need not give a reason for not participating.

There are several exemptions to this section of the law. An appointed municipal employee may file a written disclosure about the financial interest with his appointing authority, and seek permission to participate notwithstanding the conflict. The appointing authority may grant written permission if she determines that the financial interest in question is not so substantial that it is likely to affect the integrity of his services to the municipality. Participating without disclosing the financial interest is a violation. Elected employees cannot use the disclosure procedure because they have no appointing authority.

Example where there is no violation: An appointed member of the town zoning advisory committee, which will review and recommend changes to the town's by-laws with regard to a commercial district, is a partner at a company that owns commercial property in the district. Prior to participating in any committee discussions, the member files a disclosure with the zoning board of appeals that appointed him to his position, and that board gives him a written determination authorizing his participation, despite his company's financial interest. There is no violation.

There is also an exemption for both appointed and elected employees where the employee's task is to address a matter of general policy and the employee's financial interest is shared with a substantial portion (generally 10% or more) of the town's population, such as, for instance, a financial interest in real estate tax rates or municipal utility rates.

Regulatory exemptions. In addition to the statutory exemptions just mentioned, the Commission has created several regulatory exemptions permitting municipal employees to participate in particular matters notwithstanding the presence of a financial interest in certain very specific situations when permitting them to do so advances a public purpose. There is an exemption permitting school committee members to participate in setting school fees that will affect their own children if they make a prior written disclosure. There is an exemption permitting town clerks to perform election-related functions even when they, or their immediate family members, are on the ballot, because clerks' election-related functions are extensively regulated by other laws. There is also an exemption permitting a person serving as a member of a municipal board pursuant to a legal requirement that the board have members with a specified affiliation to participate fully in determinations of general policy by the board, even if the entity with which he is affiliated has a financial interest in the matter. Other exemptions are listed in the Commission's regulations, available on the Commission's website.

Example where there is no violation: A municipal Shellfish Advisory Board has been created to provide advice to the Board of Selectmen on policy issues related to shellfishing. The Advisory Board is required to have members who are currently commercial fishermen. A board member who is a commercial fisherman may participate in determinations of general policy in which he has a financial interest common to all commercial fishermen, but may not participate in determinations in which he alone has a financial interest, such as the extension of his own individual permits or leases.

(e) False claims. Presenting a false claim to your employer for a payment or benefit is prohibited, and causing someone else to do so is also prohibited. (See Sections 23(b)(4) and 26)

A municipal employee may not present a false or fraudulent claim to his employer for any payment or benefit worth \$50 or more, or cause another person to do so.

Example of violation: A public works director directs his secretary to fill out time sheets to show him as present at work on days when he was skiing.

(f) Appearance of conflict. Acting in a manner that would make a reasonable person think you can be improperly influenced is prohibited. (See Section 23(b)(3))

A municipal employee may not act in a manner that would cause a reasonable person to think that she would show favor toward someone or that she can be improperly influenced. Section 23(b)(3) requires a municipal employee to consider whether her relationships and affiliations could prevent her from acting fairly and objectively when she performs her duties for a city or town. If she cannot be fair and objective because of a relationship or affiliation, she should not perform her duties. However, a municipal employee, whether elected or appointed, can avoid violating this provision by making a public disclosure of the facts. An appointed employee must make the disclosure in writing to his appointing official.

Example where there is no violation: A developer who is the cousin of the chair of the conservation commission has filed an application with the commission. A reasonable person could conclude that the chair might favor her cousin. The chair files a written disclosure with her appointing authority explaining her relationship with her cousin prior to the meeting at which the application will be considered. There is no violation of Sec. 23(b)(3).

(g) Confidential information. Improperly disclosing or personally using confidential information obtained through your job is prohibited. (See Section 23(c))

Municipal employees may not improperly disclose confidential information, or make personal use of non-public information they acquired in the course of their official duties to further their personal interests.

III. After-hours restrictions.

(a) Taking a second paid job that conflicts with the duties of your municipal job is prohibited. (See Section 23(b)(1))

A municipal employee may not accept other paid employment if the responsibilities of the second job are incompatible with his or her municipal job.

Example: A police officer may not work as a paid private security guard in the town where he serves because the demands of his private employment would conflict with his duties as a police officer.

(b) Divided loyalties. Receiving pay from anyone other than the city or town to work on a matter involving the city or town is prohibited. Acting as agent or attorney for anyone other than the city or town in a matter involving the city or town is also prohibited whether or not you are paid. (See Sec. 17)

Because cities and towns are entitled to the undivided loyalty of their employees, a municipal employee may not be paid by other people and organizations in relation to a matter if the city or town has an interest in the matter. In addition, a municipal employee may not act on behalf of other people and organizations or act as an attorney for other people and organizations in which the town has an interest. Acting as agent includes contacting the municipality in person, by phone, or in writing; acting as a liaison; providing documents to the city or town; and serving as spokesman.

A municipal employee may always represent his own personal interests, even before his own municipal agency or board, on the same terms and conditions that other similarly situated members of the public would be allowed to do so. A municipal employee may also apply for building and related permits on behalf of someone else and be paid for doing so, unless he works for the permitting agency, or an agency which regulates the permitting agency.

Example of violation: A full-time health agent submits a septic system plan that she has prepared for a private client to the town's board of health.

Example of violation: A planning board member represents a private client before the board of selectmen on a request that town meeting consider rezoning the client's property.

While many municipal employees earn their livelihood in municipal jobs, some municipal employees volunteer their time to provide services to the town or receive small stipends. Others, such as a private attorney who provides legal services to a town as needed, may serve in a position in which they may have other personal or private employment during normal working hours. In recognition of the need not to unduly restrict the ability of town volunteers and part-time employees to earn a living, the law is less restrictive for "special" municipal employees than for other municipal employees.

The status of "special" municipal employee has to be assigned to a municipal position by vote of the board of selectmen, city council, or similar body. A position is eligible to be designated as "special" if it is unpaid, or if it is part-time and the employee is allowed to have another job during normal working hours, or if the employee was not paid for working more than 800 hours during the preceding 365 days. It is the position that is designated as "special" and not the person or persons holding the position. Selectmen in towns of 10,000 or fewer are automatically "special"; selectman in larger towns cannot be "specials."

If a municipal position has been designated as "special," an employee holding that position may be paid by others, act on behalf of others, and act as attorney for others with respect to matters before municipal boards other than his own, provided that he has not officially participated in the matter, and the matter is not now, and has not within the past year been, under his official responsibility.

Example: A school committee member who has been designated as a special municipal employee appears before the board of health on behalf of a client of his private law practice, on a matter that he has not participated in or had responsibility for as a school committee member. There is no conflict. However, he may not appear before the school committee, or the school department, on behalf of a client because he has official responsibility for any matter that comes before the school committee. This is still the case even if he has recused himself from participating in the matter in his official capacity.

Example: A member who sits as an alternate on the conservation commission is a special municipal employee. Under town by-laws, he only has official responsibility for matters assigned to him. He may represent a resident who wants to file an application with the conservation commission as long as the matter is not assigned to him and he will not participate in it.

(c) Inside track. Being paid by your city or town, directly or indirectly, under some second arrangement in addition to your job is prohibited, unless an exemption applies. (See Section 20)

A municipal employee generally may not have a financial interest in a municipal contract, including a second municipal job. A municipal employee is also generally prohibited from having an indirect financial interest in a contract that the city or town has with someone else. This provision is intended to prevent municipal employees from having an “inside track” to further financial opportunities.

Example of violation: Legal counsel to the town housing authority becomes the acting executive director of the authority, and is paid in both positions.

Example of violation: A selectman buys a surplus truck from the town DPW.

Example of violation: A full-time secretary for the board of health wants to have a second paid job working part-time for the town library. She will violate Section 20 unless she can meet the requirements of an exemption.

Example of violation: A city councilor wants to work for a non-profit that receives funding under a contract with her city. Unless she can satisfy the requirements of an exemption under Section 20, she cannot take the job.

There are numerous exemptions. A municipal employee may hold multiple unpaid or elected positions. Some exemptions apply only to special municipal employees. Specific exemptions may cover serving as an unpaid volunteer in a second town position, housing- related benefits, public safety positions, certain elected positions, small towns, and other specific situations. Please call the Ethics Commission’s Legal Division for advice about a specific situation.

IV. After you leave municipal employment. (See Section 18)

(a) Forever ban. After you leave your municipal job, you may never work for anyone other than the municipality on a matter that you worked on as a municipal employee.

If you participated in a matter as a municipal employee, you cannot ever be paid to work on that same matter for anyone other than the municipality, nor may you act for someone else, whether paid or not. The purpose of this restriction is to bar former employees from selling to private interests their familiarity with the facts of particular matters that are of continuing concern to their former municipal employer. The restriction does not prohibit former municipal employees from using the expertise acquired in government service in their subsequent private activities.

Example of violation: A former school department employee works for a contractor under a contract that she helped to draft and oversee for the school department.

(b) One year cooling-off period. For one year after you leave your municipal job you may not participate in any matter over which you had official responsibility during your last two years of public service.

Former municipal employees are barred for one year after they leave municipal employment from personally appearing before any agency of the municipality in connection with matters that were under their authority in their prior municipal positions during the two years before they left.

Example: An assistant town manager negotiates a three-year contract with a company. The town manager who supervised the assistant, and had official responsibility for the contract but did not participate in negotiating it, leaves her job to work for the company to which the contract was awarded. The former manager may not call or write the town in connection with the company's work on the contract for one year after leaving the town.

A former municipal employee who participated as such in general legislation on expanded gaming and related matters may not become an officer or employee of, or acquire a financial interest in, an applicant for a gaming license, or a gaming licensee, for one year after his public employment ceases.

(c) Partners. Your partners will be subject to restrictions while you serve as a municipal employee and after your municipal service ends.

Partners of municipal employees and former municipal employees are also subject to restrictions under the conflict of interest law. If a municipal employee participated in a matter, or if he has official responsibility for a matter, then his partner may not act on behalf of anyone other than the municipality or provide services as an attorney to anyone but the city or town in relation to the matter.

Example: While serving on a city's historic district commission, an architect reviewed an application to get landmark status for a building. His partners at his architecture firm may not prepare and sign plans for the owner of the building or otherwise act on the owner's behalf in relation to the application for landmark status. In addition, because the architect has official responsibility as a commissioner for every matter that comes before the commission, his partners

may not communicate with the commission or otherwise act on behalf of any client on any matter that comes before the commission during the time that the architect serves on the commission.

Example: A former town counsel joins a law firm as a partner. Because she litigated a lawsuit for the town, her new partners cannot represent any private clients in the lawsuit for one year after her job with the town ended.

* * * * *

This summary is not intended to be legal advice and, because it is a summary, it does not mention every provision of the conflict law that may apply in a particular situation. Our website, <http://www.mass.gov/ethics>, contains further information about how the law applies in many situations. You can also contact the Commission's Legal Division via our website, by telephone, or by letter. Our contact information is at the top of this document.

Version 6: Revised May 10, 2013

Exhibit D - Acknowledgement of Receipt of Summary

In accordance with Massachusetts General Laws, Chapter 303 of the Acts of 1975, I have been furnished a copy of the Conflict of Interest Law.

Print Name

Department / Office / Board / Committee

Address

City or, State & Zip

Phone

Email

Please sign below and return to the City Clerk's Office as required by law.

_____ **State Ethics Commission Receipt Included**

Signature

Date

Exhibit E - Affirmative Action & Equal Employment Opportunity Requirements

Pursuant to Article X, Section 1 of the Framingham Home Rule Charter adopted on April 4, 2017 “All general laws, special laws, town by-laws, town meeting votes, and rules and regulations of or pertaining to Framingham that are in force when this charter takes effect, and not specifically or by implication repealed by this charter, shall continue in full force and effect until amended or repealed, or rescinded by due course of law, or until they expire by their own limitation....”

Section 1 - AFFIRMATIVE ACTION REQUIREMENTS

Bidders are advised of the requirements of the following Town By-law, which was adopted at the Special Framingham Town Meeting of December 8, 1971 and approved by the Attorney General on March 14, 1972.

Section 2 - No Town agency shall enter into any contract for the purchase of goods or services for the construction, maintenance, renovation or repair of any building, structure, street, way, utility or other public works with any contractor which does not take affirmative action to provide equal employment for all qualified persons without regard to race, color, religion, sex or national origin.

Section 3 - Each bidder and contractor shall include with all bids and all compliance and progress reports submitted to any Town agency or a report, which shall include:

A certificate stating that he is currently in compliance with the provisions of the Massachusetts General Laws, Chapter 151 governing non discrimination in employment and setting forth the affirmative action he is currently undertaking and will undertake during the contract period to provide equal employment opportunity for all qualified persons without regard to race, color, religion, sex or national origin. A copy of any such report shall be filed in the office of the Town Clerk and shall upon filing become a public record.

Section 4 - Every Town Agency shall include in every contract hereinafter entered into the purchase of goods or services or for the construction, maintenance, renovation services or repair of any buildings, structure, street, way utility or other public works the following provisions:

During the performance of this contract, the contractor agrees as follows:

- a. The contractor will take affirmative action to ensure that employees are solicited and employed and that the employees are treated during employment without regard to race, color, religion, sex or national origin.
- b. The contractor will in all solicitation or advertisements for employees placed by 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.
- a. The contractor and subcontractors will include the provisions of subsections (a) and (b) above in every subcontract or purchase order.

Section 5 - As used in this section, affirmative action means positive steps to ensure all qualified persons equal employment without regard to race, color, religion, sex or national origin at all stages of the employment process, recruitment, selection, placement, promotion, training, layoff and termination. It may include, but not limited to the following:

- Inclusion in all solicitation and advertisements for employees of a statement that the contractor is an "Equal Opportunity Employer."
- Placement of solicitation and advertisements for employees in media that reaches minority groups.
- Notification in writing of all recruitment sources that the contractor solicits the referral of applicants without regard to race, color, religion, sex or national origin.
- Direct solicitation of the support of responsible and appropriate community, state and federal agencies to assist in recruitment efforts.
- Participation in or establishment of apprenticeship or training programs where outside programs are inadequate or unavailable to minority groups.
- Modification or collective bargaining agreements to eliminate restrictive barriers established by dual lines of seniority, dual rates of pay or dual lines of promotion or progression which are based on race, color, religion, sex or national origin.

Section 6 - The Human Relations Commission shall receive and investigate or cause to be investigated complaints by employees or prospective employees of a Town contractor, subcontractor, or supplier. Findings and determinations on such investigations, together with the records and recommendations, shall be reported by the Human Relations Commission to the Board of Selectmen and the contracting agency concerned. The Human Relations Commission shall cooperate with the Mayor and with each contracting agency by providing assistance in reviewing affirmative action plans, and to contractors seeking qualified minority group employees, and shall itself seek such employees.

Section 7 - The provision of this section shall not apply to any contract for less than \$5,000 or to bidders and contractors employing fewer than six persons provided that where the contract is for less than \$5,000 but not less than \$2,000, any City agency may apply the provision of this section to any contract, bidder, or contractor.

EQUAL EMPLOYMENT OPPORTUNITY

No person in the United States shall, on the grounds of race, color, national origin, or sex, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any program or activity receiving Federal financial assistance. Reference Title VI of the Civil Rights Act of 1964 (42 USC 2000d) and Section 112 of Public Law 92-65.

Form EDA-503. The Recipient and all Contractors, subcontractors, suppliers, lessees and other parties directly participating in the Recipient's project agree that during and in connection with the associated agreement relating to the Federally assisted program.

(1) They will comply, to the extent applicable, as Contractors, subcontractors, lessees, suppliers, or in any other capacity, with the applicable provisions of the Regulations of the United States Department of Commerce (Part 8 of Subtitle A of Title 15 of the Code of Federal Regulations)

issued pursuant to Title VI of the Civil Rights Act of 1964 (P.L. 88-352), and will not thereby discriminate against any person on the grounds of race, color, or national origin in their employment practices, in any of their own contractual arrangements, in all services or accommodations which they offer to the public, and in any of their other business operations, (2) they will provide information required by or pursuant to said Regulations to ascertain compliance with the Regulations and these assurances, and (3) their non-compliance with the nondiscrimination requirements of said Regulations and these assurances shall constitute a breach of their contractual arrangements with the Recipient whereby said agreements may be canceled, terminated or suspended in whole or in part or may be subject to enforcement otherwise by appropriate legal proceedings.

Executive Order 11246, 30 Fed. Reg. 12319 (1965) (Equal Opportunity Clause)

During the performance of this contract, the Contractor agrees as follows:

- a. The Contractor will not discriminate against any employee or applicant for employment because of race, color, religion, sex, or national origin. The Contractor will take affirmative action to ensure that applicants are employed, and that employees are treated during employment, without regard to their race, color, religion, sex, or national origin. Such action shall include, but not be limited to the following: employment, upgrading, demotion, or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship.
- b. 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 non-discrimination clause.
- c. The Contractor will, in all solicitations or advertisements 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.
- d. 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 commitment 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.
- e. The Contractor will comply with all provisions of Executive Order No. 11246 of September 24, 1965, and of rules, regulations, and relevant orders of the Secretary of Labor.
- f. The Contractor will furnish all information and reports required by Executive Order No. 11246 of September 24, 1965, and by 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, 43FR 46501, 3 CFR, 1978 Comp., p. 230. Each Contractor and subcontractor of federally financed construction work is required to file an Equal Employment Opportunity Employer Information Report (EEO-1 on Standard Form 100) annually on March 31. Forms and instructions are available at the EDA Regional Office.

- g. In the event of the Contractor' noncompliance with the non-discrimination clauses of this contract or with any such rules, regulations, or orders, this contract may be canceled, 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 September 24, 1965, and such other sanctions may be imposed (and remedies involved) 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.
- h. The Contractor will include the provisions of paragraphs a through h 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 subcontractor or purchase order as the contracting agency may direct 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 by the contracting agency, the Contractor may request the United States to enter into such litigation to protect the interest of the United States.[Sec. 202 amended by EO 11375 of Oct. 13, 1967, 32 FR 14003, 3 CFR, 1966-1970.

1. Exemptions to Above Equal Opportunity Clause (4) CFR Chap.60):

- (1) Contracts and subcontracts not exceeding \$10,000 (other than government bills of lading) are exempt. The amount of the contract, rather than the amount of the Federal financial assistance, shall govern in determining the applicability of this exemption.
- (2) Except in the case of subcontractors for the performance of construction work at the site of construction, the clause shall not be required to be inserted in subcontracts below the second tier.
- (3) Contracts and subcontracts not exceeding \$100,000 for standard commercial supplies or raw materials are exempt.

OTHER PROHIBITED INTEREST

No official of the Owner who is authorized in such capacity and on behalf of the Owner to negotiate, make, accept, or approve, or to take part in negotiating, making, accepting, or approving any architectural, engineering, inspection, construction or material supply contract or any subcontract in connection with the construction of the project, shall become directly or indirectly interested personally in this contract or in any part hereof. No officer, employee, architect, attorney, engineer or inspector of or for the Owner who is authorized in such capacity and on behalf of the Owner to exercise any legislative, executive, supervisory or other similar functions in connection with the construction of the project, shall become directly or indirectly interest personally in this contract or in any part thereof, any material supply contract, subcontract, insurance contract, or any other contract pertaining to the project.

City of Framingham, Massachusetts

Date _____

To: City of Framingham, Framingham, MA

I have read the Affirmative Action Requirements and Equal Employment Opportunity as adopted by the Town of Framingham on December 8, 1971 and approved by the Massachusetts Attorney General on March 14, 1972 and agree to affirmatively implement all practices necessary to comply with said requirements.

A copy of a portion of the Town By-law is attached as part of the bid specifications.

Signed _____
Name Title

Company _____

Contract No.: [PW1025] For: [Worcester Road Sewer Pump Station Replacement]

Exhibit F - Disadvantaged Business Enterprise Program Background

In May 2008 a new 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 State Office of Minority and Women Business Assistance (SOMWBA), recently renamed 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 (formerly SOWMBA) will continue to be the certifying agency for the SRF program.

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/MBWE) 4.20% Disadvantaged WBE (D/WBE) 4.50%

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 Water Pollution Abatement 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 Water Pollution Abatement 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.

- A. 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.
- B. The SDO “DBE Certification” as prepared by each certified DBE.
- C. 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.

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 as part of the bid. 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):

- An individual
- A partnership
- A corporation
- A joint venture with: _____
- 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:	

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**

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
<hr/> Subcontractor Signature		<hr/> 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. () _____ Ext. _____

Minimum Requirements

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

- A. A detailed record of the effort made to contact and negotiate with disadvantaged minority and/or woman owned businesses, including:
 - 1. names, addresses, telephone numbers and contact dates of all such companies contacted;
 - 2. copies of written notice(s) which were sent to DBE potential subcontractors prior to bid opening;
 - 3. a detailed statement as to why each subcontractor contacted (i) was not willing to do the job or (ii) was not qualified to perform the work as solicited; and
 - 4. in the case(s) where a negotiated price could not be reached the bidder should detail what efforts were made to reach an agreement on a competitive price.

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

--	--	--	--	--	--	--	--	--

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

SECTION C: PREVAILING WAGE REQUIREMENTS

[
]

THE REMAINDER OF THIS PAGE IS LEFT BLANK INTENTIONALLY

SECTION D: OFFICIAL BID PACKAGE

CITY OF FRAMINGHAM

IFB [PW - 1025]

[Contract: Worcester Road Sewer Pump Station Replacement]

1. CHECKLIST

This checklist is provided to assist Bidders in identifying those sections of the Bid Documents which must be completed and returned as a part of the Bid submission, as well as other items to be submitted with the Bid. This is a working document for information only.

ITEM	SECTION	ACTION REQUIRED	CHECK
Addenda (if applicable)	A.5, D.2	Acknowledge all addenda issued	
Signature of Bidder	D.2	Bidder's authorized signature	
Certificate of Corporate Authority	D.3	Authorized Signatures and Notary	
Price Sheet	D.4	Unit Prices, Extensions, Totals	
Bidder Information	D.5	Provide information	
Bidder References	D. 6	Provide information	
Bid Deposit (Bid Bond or Certified Check, etc.)	D.7	Authorized signatures by Bidder and Surety Furnish in separate envelope for <u>5%</u> of the value of the Bid.	
Attestation of Tax Compliance	D.8	Bidder's authorized signature	
Certificate of Non-Collusion	D.9	Bidder's authorized signature	
Affirmative Action & Equal Employment Opportunity	B., E.	Bidder's authorized signature	
MA Diesel Retrofit Form	D.10	Filled out and authorized signatures	

2. SIGNATURE OF BIDDER

To the City of Framingham:

1. The Undersigned hereby offers to perform all the obligations and to assume all the duties and liabilities of the Contractor provided for in the accompanying Section A, entitled “Instructions to Bidders”; Section B, entitled “Short Form of Agreement”; Section C, entitled “Prevailing Wage Requirements”, this Section D, entitled “Bid Package”; Section E, entitled “General Conditions”; Section F, entitled “Supplementary Conditions”; and Section G, entitled “Specifications”.
2. This Bid includes Addenda numbered _____.
3. The Undersigned declares that the Contract Documents have been examined carefully and that the Bidder is familiar with all of the requirements as set forth in the Contract Documents. Further, the Bidder has had an opportunity to ask questions and has secured satisfactory responses to such questions and understands that by submitting this Bid, the bidder waives any and all rights to plead any misunderstandings.
4. The Undersigned, under penalties of perjury hereby certifies the following: (1) that s/he is able to furnish labor that can work in harmony with all other elements of labor employed or to be employed in the work; (2) that all employees to be employed at the worksite will have successfully completed a course in construction safety and health approved by the United States Occupational Safety and Health Administration that is at least 10 hours in duration at the time the employee begins work and such documentation of successful completion of said course shall be furnished with the first certified payroll report for each employee.
5. The Undersigned agrees that, if selected as the Contractor, s/he will within ten (10) calendar days of the notification of contract award by the City, execute a contract in accordance with the terms and conditions of this bid and furnish a certificate of foreign corporation if required, and a payment bond as required under section 29 of chapter 149 and any other bonds as may be additionally required in the Contract, each of a surety company qualified to do business under the laws of the Commonwealth and satisfactory to the City and each in the sum set forth in the City’s Short Form of Agreement, Article 10, the premiums for which are to be paid by the Contractor and are included in the contract price.
6. This offer shall be irrevocable for 90 calendar days after the date on which the City opens this Bid. The parties, by mutual agreement, may extend the time for acceptance of the Bid, during which time there will be no increase in Bid price or contract term.

7. 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.

8. The undersigned further certifies under penalty of perjury that the said undersigned is not presently debarred from doing public construction work in the Commonwealth 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 regulation 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.

9. The EPA prohibits the use of suspended or debarred contractors and suppliers in SRF contracts. Bidders must fully comply with Subpart C of 2 CFR Part 180 and 2 CFR Part 1532, entitled Responsibilities Regarding Transactions (Doing Business with Other Persons). Contractors, subcontractors, or suppliers that appear on the Excluded Parties List System at www.epls.gov are not eligible for award of any contracts funded by the Massachusetts State Revolving Fund.

10. The undersigned Bidder hereby certified that he/she will comply with the specific affirmative action steps contained in the EEO/AA provisions of this Contract, including compliance with the Disadvantaged Business Enterprise provisions as required under these Contract provisions. The Contractor receiving award of the Contract shall incorporate EEO/AA provisions of this Contract into all subcontracts and purchase orders so that such provisions will be binding upon each subcontractor or vendor.

11. The Undersigned represents and warrants that the Bidder has full and complete authority to submit this Bid and enter into a contract with the City of Framingham.

Date: _____

Name of Bidder: _____

Business Street Address: _____

City, State and Zip Code: _____

Phone: (____) _____ Fax: (____) _____

E-Mail: _____

(*)*Authorized Written Signature:* _____

Printed Name: _____

Title: _____

(*)Note: Bid should be signed in ink by a person having proper legal authority, and the person's title should be given, such as "owner" in the case of an individual, "partner" in the case of a general partnership, "president", "treasurer" or other authorized officer in the case of a corporation.

If Bidder is a partnership, **provide signature of one co-partner above and provide signatures of the remaining partners below (attach additional sheets if necessary):**

Written Signature Printed Name

Written Signature Printed Name

Written Signature Printed Name

Written Signature Printed Name

3. CERTIFICATE OF CORPORATE AUTHORITY

AT A DULY AUTHORIZED MEETING OF THE BOARD OF DIRECTORS OF THE _____
(name of corporation)

held on _____ Directors were present or waived notice, it was voted that _____
(date)

_____ of this company be and hereby is authorized to execute contracts and bonds
(name and title)

in the name and behalf of said company, and affix its Corporate Seal thereto, and such execution
of any contract or bond of obligation in this company's name on its behalf of such _____

(OFFICER)

under seal of the company shall be valid and binding upon this company.

A TRUE COPY,

ATTEST: _____

Place of Business:

I hereby certify that I am the _____ of the _____
(Title) (Name of Corporation)

that _____ is the duly elected _____ of said
(Name of Officer) (Title)

company, and the above vote has not been amended or rescinded and remains in full force and
effect as of the date of this contract.

Signature: _____

Name/Title: _____

Date: _____

(Corporate Seal)

COMMONWEALTH OF MASSACHUSETTS, SS. _____, [2022]

Then personally appeared the above named _____ and acknowledged the
foregoing instrument to be his/her free act and deed before me.

NOTARY PUBLIC _____

My commission expires: _____

4. PRICE SHEET

Instructions:

- (1) Insert Bid Price**
- (2) Multiply the Estimated Quantity by the Unit Price and Insert the product for Total Price**
- (3) Add all products in the Total Price Column and insert the sum for Total Estimated Price for Bid Evaluation Purposes**
- (4) In the event of a discrepancy between a Bid Price and Total Price, the Unit Price shall control.**
- (5) Refer to Section XXXXX – Measurement and Payment for Item Descriptions**

Item No.	Estimated Quantity	Unit	Description	(1) Unit Price	(2) Total Price
1A	1	LS	Worcester Road Sewer Pumping Station Replacement	\$	\$
1B	1	LS	Wastewater Bypass System Equipment Rental	\$	\$
1C	1	LS	Wastewater Bypass System Operation and Maintenance	\$	\$
1D	1	LS	Installation and Restoration for Wastewater Bypass System	\$	\$
1E	1	LS	Dewatering Treatment System	\$	\$
2A	1	Allowance	Utility Service Allowance	\$50,000.00	\$50,000.00
2B	1	Allowance	Testing Lab Services Allowance	\$10,000.00	\$10,000.00
2C	1	Allowance	Service of Uniformed Traffic Officers	\$100,000.00	\$100,000.00
3	100	CY	Rock Excavation & Disposal	\$	\$
4	100	CY	Gravel Borrow	\$	\$
5	100	CY	Crushed Stone	\$	\$
6	275	LF	Crack Repair by Epoxy Injection	\$	\$
7A	1	LS	Management of Soil/Fill and Contaminated Materials	\$	\$
7B	100	CY	Remove and Dispose of Background Material	\$	\$
7C	100	Ton	Remove and Dispose of Impacted Material	\$	\$

5. BIDDER INFORMATION

Bidder: _____

Business Trade or Field: _____

Previous experience in this trade or field is _____ years.

Equipment owned by the Bidder and planned to be used on jobs in Framingham:

Bidder shall list all projects that his/her company defaulted on and reasons for defaults:

6. BIDDER REFERENCE FORM

Bidder Name: _____

Please provide a list of references on the firm’s performance of similar work as required by this IFB within the required time period designated in Section A, under the Item entitled “Bidder Prerequisites”, including all current contracts. Use additional sheets as necessary. Include the following information for each reference:

Reference One

Customer Name: _____

Address: _____

Contact Name and Title: _____

Phone and Fax/E-Mail of Contact: _____

Contract date(s): _____

Contract cost: _____

Description of Work: _____

Reference Two

Customer Name: _____

Address: _____

Contact Name and Title: _____

Phone and Fax/E-Mail of Contact: _____

Contract date(s): _____

Contract cost: _____

Description of Work: _____

Reference Three

Customer Name: _____

Address: _____

Contact Name and Title: _____

Phone and Fax/E-Mail of Contact: _____

Contract date(s): _____

Contract cost: _____

Description of Work: _____

Reference Four

Customer Name: _____

Address: _____

Contact Name and Title: _____

Phone and Fax/E-Mail of Contact: _____

Contract date(s): _____

Contract cost: _____

Description of Work: _____

Reference Five

Customer Name: _____

Address: _____

Contact Name and Title: _____

Phone and Fax/E-Mail of Contact: _____

Contract date(s): _____

Contract cost: _____

Description of Work: _____

Reference Six

Customer Name: _____

Address: _____

Contact Name and Title: _____

Phone and Fax/E-Mail of Contact: _____

Contract date(s): _____

Contract cost: _____

Description of Work: _____

7. BID BOND

KNOW ALL MEN BY THESE PRESENTS, that we:

(insert full Name and Address of Bidder)

as Principal, hereinafter called the Principal, and :

(insert full Name and Address of Surety)

as Surety, a corporation duly organized under the laws of the State of _____, and duly registered to conduct a surety business in Massachusetts, hereinafter called the Surety, are held and firmly bound unto CITY OF FRAMINGHAM, Framingham, Massachusetts, as Obligee, hereinafter called the Obligee, in the sum of Five Percent (5%) of the total amount bid for the payment of which sum well and truly be made, the said Principal and the said Surety, bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, the Principal has submitted a Bid for:

(insert full Name of Project)

NOW, THEREFORE, if the Obligee shall accept the Bid of the Principal and the Principal shall enter into a Contract with the Obligee in accordance with the terms of such Bid, and give such bonds as may be specific in the Bid Documents with good and sufficient surety for the faithful performance of such Contract and for the prompt payment of labor and materials furnished in the persecution therefore, and such other documents as may be required by the Bid Documents, then this obligation shall be null and void; but in the event of the failure of the Principal following Obligee’s acceptance of Principal’s Bid to enter such Contract and give such bonds within ten (10) calendar days of receipt of such Contract, or such other documents as may be required, this obligation shall remain in full force and effect, and the Surety shall pay to the Obligee the difference not to exceed the penalty hereof between the amount specified in said Bid and such larger amount for which the Obligee may in good faith contract with another party to perform the Work covered by said Bid.

Signed and sealed this _____ day of _____, [2022_]

(Principal)

Witness as to Principal

(Seal)

(Title)

(Surety)

Witness as to Surety

(Seal)

(Title)

8. ATTESTATION OF TAX COMPLIANCE

I certify under the penalties of perjury that, to the best of my knowledge and belief, I am in compliance with all laws of the Commonwealth relating to taxes, reporting of employees and contractors, and withholding and remitting child support. Pursuant to M.G.L. ch. 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.

*Signature of Individual or
Corporate Name (**Mandatory**)

**Social Security Number or Federal
Identification Number (**Mandatory**)

By: _____
Corporate Officer
(**Mandatory, if Applicable**)

Date: _____

*Approval of a contract or other agreement will not be granted unless this certification clause is signed by the applicant.

Your social security number will be furnished to the Massachusetts Department of Revenue to determine whether you have met tax filing and tax payment obligations. Providers who fail to correct their non-filing or delinquency status **will not have a contract or other agreement issued, renewed, or extended. This request is made under the authority of Mass. G.L. Ch. 62c, Sec.49A.

9. CERTIFICATE OF NON-COLLUSION

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

(Signature of Person Signing Bid)

10. MA DIESEL RETROFIT PROGRAM STATEMENT OF INTENT TO COMPLY

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

Local Governmental Unit : City of Framingham, MA

SRF Project No. : XXXX- xxxx

Contract No. : PW-1025

Contract Title: Worcester Road Sewer Pump Station Replacement]

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 DEP'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.

Signed under penalties of perjury.

Signature of authorized representative of contractor

Print name of authorized representative of contractor

Date

SECTION E: GENERAL CONDITIONS

[
]

SECTION F: SUPPLEMENTARY CONDITIONS

SC-3.06	Copies of Documents	SC00700-80
SC-4.02	Subsurface and Physical Conditions	SC00700-80
SC-4.06	Hazardous Environmental Conditions	SC00700-80
SC-6.02.I	SC00700-81
SC-6.06	SC00700-89
SC-7.02	SC00700-90

These Supplementary Conditions amend or supplement the Standard General Conditions of the Construction Contract. All provisions which are not so amended or supplemented remain in full force and effect.

The terms used in the Supplementary Conditions have the meanings stated in the General Conditions. Additional terms used in these Supplementary Conditions have the meanings stated below, which are applicable to both the singular and plural thereof.

The address system used in the Supplementary Conditions is the same as the address system used in the General Conditions, with the prefix “SC” added thereto.

SC-3.06 Copies of Documents

(If electronic docs are to be given)

SC-4.02 Subsurface and Physical Conditions

Strike paragraph 4.02 and replace it with the following:

4.02. Subsurface and Physical Conditions: The Owner is aware of the following reports and/or explorations and/or tests of subsurface conditions at or contiguous to the Site: The Owner makes no representations regarding the contents of those reports including but not limited to the accuracy, completeness, data, and subjective content of those reports except as specified in Article 4.06. Geologic Report and Logs presented as Appendix E with these Contract Documents.

SC-4.06 Hazardous Environmental Conditions

Add the following subparagraphs 4.06.A.1 and 4.06.A.2:

1. The following reports regarding Hazardous Environmental Conditions at the Site are known to Owner:
 - a. Report dated May 13, 2022, prepared by BETA Group, Inc. The “technical data” contained in such report upon which the Contractor may rely is the Laboratory Certificates of Analysis, included with the report in Appendix A.
 - b. Report dated May 2022, prepared by BETA Group, Inc.. The “technical data” contained in such report upon which Contractor may rely is PCB laboratory Certificates of Analysis, included with the report in Appendix G.

2. The following drawings regarding Hazardous Environmental Conditions at the Site are known to Owner:

none

a.

SC-6.02.1 Labor; Working Hours

Add the following:

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 subgrant 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 <http://www.dol.gov/esa/whd/forms/wh347instr.htm> 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.

2. Contract Work Hours and Safety Standards Act

(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.

3. 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 <http://www.dol.gov/esa/contacts/whd/america2.htm>.

SC-6.06 Concerning Subcontractors, Suppliers and Others

Add the following subparagraph to 6.06.B:

1. The Successful Bidder shall identify the following [Subcontractor(s), and/or Supplier(s), and/or other individual(s) or entity(ies)] within five (5) days of the Notification of Award by the Owner.)

SC-7.02 Coordination

Add the following new paragraph after Paragraph 7.02(B): “C. [either] The Owner does not intend to contract with others for the performance of other work on the Project at the Site.

]

SECTION G: SPECIFICATIONS

[
]

**SECTION H: SPECIFICATIONS
TABLE OF CONTENTS**

<u>Section Number</u>	<u>Title</u>	<u>Page No.</u>
Division 1 General Requirements		
01010	Summary of Work	01010-1 to 01010-3
01015	Special Conditions	01015-1
01020	Allowances	01020-1 to 01020-2
01025	Measurement and Payment	01025-1 to 01025-5
01040	Coordination	01040-1 to 01040-2
01045	Cutting, Coring and Patching	01045-1 to 01045-3
01050	Field Engineering	01050-1 to 01050-2
01060	Regulatory Requirements	01060-1 to 01060-2
01069	Health and Safety Requirements	01069-1 to 01069-3
01090	Reference Standards	01090-1 to 01090-5
01200	Project Meetings	01200-1 to 01200-2
01300	Submittals	01300-1 to 01300-4
01310	Construction Progress Schedule	01310-1 to 01310-4
01381	Audio Video Recording	01381-1 to 01381-2
01400	Quality Control	01400-1 to 01400-2
01410	Testing Laboratory Services	01410-1 to 01410-3
01510	Temporary Utilities	01510-1 to 01510-2
01525	Temporary Enclosures	01525-1 to 01525-2
01560	Temporary Controls	01560-1 to 01560-4
01600	Materials and Equipment	01600-1 to 01600-2
01665	Services of Manufacturer's Representative	01665-1 to 01665-8
01680	Equipment and System Checkout, Certifications and Testing	01680-1 to 01680-7
01700	Contract Closeout	01700-1 to 01700-4
01710	Startup	01710-1 to 01710-3
01730	Operations and Maintenance Manuals	01730-1 to 01730-3
01740	Warranties	01740-1 to 01730-2
01750	Spare Parts	01750-1 to 01750-2
01751	Lubricants	01751-1 to 01751-2
01800	Maintenance	01800-1 to 01800-2
Division 2 Site Work		
02050	Demolition	02050-1 to 02050-4
02076	Asbestos-Cement Pipe Removal	02076-1 to 02076-24
02080	Soil and Waste Management	02080-1 to 02080-28
02082	Asbestos Abatement	02082-1 to 02082-41
02090	Lead Based Paint and Off-Site Management	02090-1 to 02090-7
02095	PCB Removal and Related Work	02095-1 to 02095-14
02100	Site Preparation	02100-1 to 02100-4
02140	Dewatering	02140-1 to 02140-8
02149	Maintaining Existing Flow	02149-1 to 02149-5
02200	Earth Excavation, Backfill, Fill and Grading	02200-1 to 02200-13
02215	Aggregate Materials	02215-1 to 02215-4

02272 Geotextile Materials 02272-1 to 02272-5

TABLE OF CONTENTS

<u>Section Number</u>	<u>Title</u>	<u>Page No.</u>
02470	Helical Pile Foundation	02470-1 to 02470-6
02500	Paving	02500-1 to 02500-8
02607	Precast Concrete Manholes	02607-1 to 02607-7
02618	Ductile Iron Pipe and Fittings (for buried service)	02618-1 to 02618-10
02619	Valves, Hydrants and Fitting	02619-1 to 02619-8
02667	Water Service Connections	02667-1 to 02667-4
02704	Pipeline Pressure and Leakage Testing	02704-1 to 02704-5
02769	Disposal of Materials	02769-1 to 02704-2
02831	Chain Link Fencing	02831-1 to 02831-9
02930	Loaming and Seeding	02930-1 to 02930-3
Division 3 Concrete		
03300	Cast-In-Place Concrete	03300-to 03300-10
03930	Concrete Rehabilitation	03930-1 to 03930-4
03940	Crack Repairs By Epoxy Injection	03940-1 to 03940-5
Division 4 Masonry		
04230	Reinforced Unit Masonry	04230-1 to 04230-4
04810	Unit Masonry	04810-1 to 04810-18
Division 5 Metals		
05120	Structural Steel Framing	05120-1 to 05120-11
05310	Steel Roof Deck	05310-1 to 05310-5
05400	Cold Formed Metal Framing	05400-1 to 05400-9
05500	Metal Fabrication	05500-1 to 05500-11
05521	Pipe and Tube Railings	05521-1 to 05521-11
Division 6 Wood and Plastics		
06105	Miscellaneous Rough Carpentry	06105-1 to 06105-8
Division 7 Thermal and Moisture Protection		
07210	Thermal Insulation	07210-1 to 02710-5
07211	Foamed-In-Place Insulation	07211-1 to 07211-4
07272	Fluid-Applied Membrane Air Barriers	07272-1 to 07272-12
07275	Water-Resistive Air-Barrier Membranes	07275-1 to 07275-10
07421	Composite Framing Support System	07421-1 to 07421-9
07423	Metal Composite Material Wall Panels	07423-1 to 07423-15
07427	High Performance GFRC Wall Panels	07427-1 to 07427-11
07543	Thermoplastic Polyolefin (TPO) Roofing	07543-1 to 07543-14
07620	Sheet Metal Flashing and Trim	07620-1 to 07620-14

TABLE OF CONTENTS

<u>Section Number</u>	<u>Title</u>	<u>Page No.</u>
07841	Penetration Firestopping	07841-1 to 07841-10
07920	Joint Sealants	07920-1 to 07920-10
Division 8 Doors and Windows		
08110	Hollow Metal Doors and Frames	08110-1 to 08110-9
08520	Aluminum Windows	08520-1 to 08520-14
08800	Glazing	08800-1 to 08800-12
Division 9 Finishes		
09882	Epoxy Lining System	09882-1 to 09882-8
09910	Painting	09910-1 to 09910-12
09960	High Performance Coatings	09960-1 to 09960-6
Division 10 Specialties		
10155	Toilet Compartments	10155-1 to 10155-4
10240	Equipment Screens	10240-1 to 10240-7
10801	Toilet and Bath Accessories	10801-1 to 10801-5
Division 11 Equipment		
11282	Stainless Steel Gates and Appurtenances	11282-1 to 11282-11
11310	Sewage Pumps and Appurtenances	11306-1 to 11306-7
11400	Polyethylene Chemical Storage Tanks	11400-1 to 11400-7
11550	Odor Control System	11550-1 to 11550-5
11961	Interior & Exterior Process Piping	11961-1 to 11961-6
Division 14		
14600	Hoisting Equipment	14600-1 to 14600-5
Division 15 Mechanical		
15050	Pipe Penetrations	15050-1 to 15050-2
15070	Ductile Iron Pipe and Fittings	15070-1 to 15070-10
15100	Valves, Gates and Appurtenances	15100-1 to 15100-21
15130	Gauges	15130-1 to 15130-3
15140	Pipe Hangers and Supports	15140-1 to 15140-10
15400	Plumbing	15400-1 to 15400-18
15500	Heating, Ventilation, and Air Conditioning (HVAC)	15500-1 to 15500-33
Division 16 Electrical		
16000	Basic Electrical Requirements	16000-1 to 16000-9

TABLE OF CONTENTS

<u>Section Number</u>	<u>Title</u>	<u>Page No.</u>
16060	Grounding System	16060-1 to 16060-4
16080	Underground Systems	16080-1 to 16080-2
16085	Miscellaneous Equipment	16085-1 to 16085-8
16120	Wires and Cables	16120-1 to 16120-3
16130	Raceways and Fittings	16130-1 to 16130-6
16441	Switchboards	16441-1 to 16441-10
16442	Panelboards	16442-1 to 16442-4
16495	Variable Frequency Drives	16495-1 to 16495-6
16500	Lighting Systems	16500-1 to 16500-4
16612	Engine Generator	16612-1 to 16612-12
16720	Security Alarm System	16720-1 to 16720-9
16740	Communication System	16740-1 to 16740-5

Division 17 Instrumentation and Controls

17300	Instrumentation and Controls	17300-1 to 17300-37
17320	Control System Equipment Panels and Racks	17320-1 to 17320-13

Appendix

A	Worcester Road Pump Station – Hazardous Materials Survey
B	City of Framingham Construction Standards
C	Framingham Conservation Order of Conditions
D	SCADA Panel Drawings
E	Geotechnical Report and Boring Logs
F	City of Framingham Noise Ordinance
G	Risk Based PCB Bulk Product Waste Disposal Plan
H	MassDOT Access Permit

THIS PAGE INTENTIONALLY LEFT BLANK

DIVISION 01

THIS PAGE INTENTIONALLY LEFT BLANK

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 and Owner's occupancy requirements.

1.02 WORK COVERED BY CONTRACT DOCUMENTS

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

- Demolition of existing sewer pump station components including:
 - Pump station building complete (except for the concrete foundation)
 - Two (2) 50-hp wastewater pumps, piping, valves and appurtenances.
 - One (1) engine driven wastewater pump, piping, valves and appurtenances.
 - Standby natural gas fired engine and appurtenances
 - Standby natural gas fired electric generator
 - Electric components, including the motor control center, incoming power supply, lighting, switches, and power receptacles
 - Chemical feed pumps, tanks and associated piping
- Construction of a new wastewater pump station components including:
 - Pump station structure complete
 - Three (3) 60-hp immersible solids handling wastewater pumps, piping, valves and appurtenances
 - Three (3) 0.5 -hp chemical feed pumps, two (2) storage tanks, piping and appurtenances.
 - Electrical components, including variable frequency drives, incoming power supply, lighting, switches, and power receptacles
 - Exterior standby engine/generator with integral diesel fuel storage tank, piping, valves and appurtenances
 - Instrumentation and control equipment
 - Communications and Security/Access Controls
 - Epoxy coating of wet well and parshall flume chamber
 - Remove and replace paving
 - Restoration of all disturbed areas
- Construction of a temporary sewer bypass system.
- Hazardous Material Abatement
- All related civil, architectural, structural, heating and ventilation, plumbing, electrical and instrumentation control work, yard piping and site work all as more

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

1.03 OWNER

- A. City of Framingham DPW
110 Western Avenue
Framingham, Ma 01702
Telephone: (508) 532-6039
Fax: (508) 620-4884
Contact: Robert Marchesseault, PE
Senior Project Manager - Utilities

1.04 PROJECT LOCATION

- A. 730 Worcester Road
Framingham, MA 01702

1.05 ENGINEER

- A. BETA Group, Inc.
701 George Washington Highway
Lincoln, Rhode Island 02865
Telephone: 401-333-2382
Fax: 401-333-9225
Contact: James Dymont, P.E.

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 the Contract Agreement, for the performance of the Work.
- B. The Contractor shall assume full responsibility for security of all materials and equipment on the site, including those of his subcontractor's.
- C. If directed by the Owner, the Contractor shall move any stored items that interfere with operations of the Owner.

D. Obtain and pay for use of additional storage or work areas if needed to perform the Work.

1.08 OWNER OCCUPANCY REQUIREMENTS

A. The existing wastewater system serviced by the existing Worcester Road Wastewater Pumping Station must remain in full service at all times, throughout the duration of the project. Contractor shall conduct his operations in accordance with Section 02149 – Maintaining Existing Flow.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

NOT USED

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 01015

SPECIAL CONDITIONS

1.01 BYPASS PIPING PLAN

- A. The Contractor shall be required to submit a plan depicting the bypass pipe sizes, pump sizes, locations, proposed suction piping to existing sewer manholes, discharge piping to proposed connection on the existing force main, and an associated sequence of operation associated with said plan. The bypass system shall be designed and stamped by a professional engineer registered in the Commonwealth of Massachusetts. The bypass shall be integrated with the City's SCADA system.
- B. The Engineer shall retain the right to request any additional information that he or she feels ensures the integrity of the existing system, and consequently, should be incorporated into the submittal.
- C. The submittal shall be in the form of a shop drawing and no work may proceed without the approval of said shop drawing by the Engineer.
- D. Refer to specification section 02149 – Maintaining Existing Flows for requirements.

1.02 CITY OF FRAMINGHAM CONSERVATION COMMISSION

- A. The Contractor shall note that the City of Framingham's Conservation Commission Order of Conditions is located in Appendix C of these Specifications. The Contractor is required to review, familiarize himself, and conduct his operations in conformance with all Conditions identified in the Order. All of the proposed work on the project is within jurisdictional area of Framingham's Conservation Commission.
- B. The Contractor shall be required to install straw wattles as shown on the Contract drawings, install silt sacks in all catch basins within the limits of the work zone, develop a dewatering plan to be reviewed and approved by the Engineer and Conservation Agent, as required. Any changes to the dewatering plan in order to obtain approval by the Conservation Agent shall be considered incidental and no extra payment or change order shall be given.

1.03 EXCAVATIONS

A. Test Pits

- 1. Prior to the start of any construction, the Contractor must conduct test pits as shown on the Contract Drawings, at locations where indicated, where directed by the Engineer, and to verify site conditions described in Paragraph 1.03A 2 of this section.

2. Test pits shall be conducted to field verify exact size, material, location, elevation, alignment (vertical and horizontal) of existing piping and utilities.
3. Test pit soil shall be returned to the excavation once the test pits are completed. Any excess excavated test pit soil shall be managed in accordance with Section 02080, the Utility Related Abatement Measure, and the Contractor's approved soil management plan.
4. The Contractor is to provide record of utility elevation, size, material, and alignment to the Engineer upon completion of the test pits. The Contractor shall notify the Engineer of any conflicts between the proposed piping and existing piping or utilities prior to starting installation of the proposed piping. The test pits are to be completed in the presence of the Engineer. Provide 48-hours notice to the Engineer prior to completing test pits.

1.04 PROJECT STAGING AREA

- A. The Contractor is responsible for identifying and securing a staging area within the City limits for the project. The City will **not** be providing a staging area for the project. The Contractor shall bear all costs associated with the selected staging area and its use. The Contractor is responsible for securing all required permits to utilize the selected property for the Contractor's intended use.

1.05 SOIL STOCKPILE

- A. Stockpiling of excess soil is **not permitted** on the pump station site. Soil must be moved offsite to the temporary soil staging area located at 229 Arthur Street by the end of each working day.
- B. Soil shipped from the Worcester Road pump station site to 229 Arthur Street shall be documented on Massachusetts Department of Environmental Protection Material Shipping Record & Log (MSR) form. An estimated volume of each individual load shall be included on the MSR form.
- C. Access to the Arthur Street location is between 7:30 am to 3:00 pm. Trucks shall not idol outside the gate while waiting for access at any time. Soil shall only be transported to Arthur Street during the stated hours.
- D. If excavation takes place overnight the soil shall be temporarily stored at the pump station site until the next working day. The soil will then be transported to the Arthur Street location during the hours listed above.
- E. Soil shall be stored at Arthur Street a maximum of 90-working days after the date of excavation.
- F. The Contractor shall provide all equipment, labor, and materials associated with handling the excess soil as specified and detailed.

G. Soil stockpile area as shown on CD-2 shall be provided, maintained, and removed by the contractor at 229 Arthur Street.

1.06 KNOWN CONTAMINATION

A. Impacted soil and groundwater have been identified at the site. See Appendix A for additional information.

B. A hazardous building material assessment was completed for the project on the existing pump station. See Appendix A for additional information.

C. PCBs have been identified in painted surfaces within the existing pump station. See Appendix G for additional documentation.

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 01020

ALLOWANCES

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes

1. Allowances and their respective value which have been established in the BID as an estimated lump sum to facilitate comparison of bids only.

B. Related Sections

1. Section 01025 - Measurement and Payment

1.02 ALLOWANCES

A. Utility Service Allowance - Bid Item No. 2A.

1. Allowance is specific to services provided by Eversource Electric and Gas.
2. Provide the new electric and gas service as shown on the Contract Drawings, required by the Eversource or as directed by the Engineer.
3. Coordinate all work with the respective utility company or department providing access to the site at the appropriate time to prevent any delay in the Work specified to be done under these Contract Documents.

B. Testing Lab Services Allowance - Bid Item No. 2B.

1. Allowance is specific to additional laboratory testing requested by the Owner. **All costs for testing required by the Contract Documents shall be included in the Contractor's Bid Item 1A.**

C. Service of Uniformed Traffic Officers - Bid Item No. 2C.

1. Allowance is specific to services provided by uniformed traffic officers.
2. Costs associated with coordination and scheduling service of uniformed officers is to be included in the Contractor's Bid Item 1A.

1.03 PAYMENT PROCEDURES

A. Under this item, the Contractor shall be reimbursed for charges for the allowances required and authorized by the Owner and Engineer, as detailed in Section 01025 - Measurement and Payment.

B. The lump-sum price for this allowance is established in the Bid Forms as an estimated figure to facilitate comparison of bids only. The actual amount to be paid under this item shall constitute full compensation for services rendered.

- C. The lump-sum price for this item shall NOT include any costs associated with services rendered for routine utility markings, repair damages incurred as a result of the Contractor's operations, relocations of utilities done at the Contractor's request and/or convenience, or any other unauthorized services rendered by utility companies. The purpose of this item is strictly for the Contractor's reimbursement for those services authorized by the Owner or Engineer prior to the work being performed.
- D. The Contractor will be paid based on the actual PAID invoiced amount from the authority in question as approved by the Engineer. If the total cost for such charges is greater or less than the allowance amount stated under this item of the BID, a debit or credit of the difference in cost shall be to the Owner.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Materials as required and ordered by the Engineer shall conform to the Contract Documents.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Installation, relocation, or repair of utilities, shall be performed in accordance with the Contract Documents.

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.

B. RELATED SECTIONS

1. INVITATION FOR BIDS - Bid Package
3. Section 01020 - Allowances

1.02 UNIT QUANTITIES SPECIFIED

- ###### A. Quantities and measurements indicated in "Invitation for Bids, Section D, Bid Package" are for bidding and contract purposes only.

- ###### B. Payment will be made in accordance with the Standard General Conditions.

1.03 MEASUREMENTS OF QUANTITIES

- ###### A. Measurement by Volume: Measured by cubic dimension using mean length, width and height or thickness.

- ###### B. Measurement by Area: Measured by square dimension using mean length and width or radius.

- ###### C. Linear Measurement: Measured by linear dimension, along the horizontal projection of the centerline or mean chord.

- ###### D. At appropriate points in this text, specifications are given with respect to measuring or estimating certain quantities and the sums due for the same. Except as otherwise provided, the Engineer shall determine the appropriate method for measuring and computing each quantity, and for estimating the sums due for the various kinds of work and material, using such methods, tools and degrees of precision as are suitable for the particular measurement, Item or computation. When so requested by the Engineer, assistance in measuring or determining quantities, shall be provided by furnishing the help of unskilled laborers on the site, by furnishing copies of invoices, or by other means.

- ###### E. For estimating quantities in which the computations of areas by analytic and geometric methods would be laborious, as determined by the Engineer, it is stipulated

and agreed that the planimeter shall be considered an instrument of precision adapted to the measurement of such areas and may be used for this purpose.

1.04 UNIT PRICES

- A. Payment will be computed on the basis of the unit price bid in “SECTION D: Bid Package” for each Item and the quantity of units completed. Unit prices are to include cost of all necessary materials, labor, equipment, overhead, profit and other applicable costs. (See Par. 1.06, this Section.)

1.05 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.)
- B. The Contractor's Schedule of Values (submit under Article 2.03 B.3 of the Standard General Conditions) of the lump sum bid will be used only as a guide to determine the percentage of completion.

1.06 PRICES INCLUDE

- A. The prices stated in the Proposal include full compensation not only for furnishing all the labor, equipment and material needed for, and for performing the Work and building the structures contemplated by, the Contract, but also for assuming all risks of any kind for expenses arising by reason of the nature of the soil, groundwater, or the action of the elements; for all excavation and backfilling; for the removal of and delay or damage occasioned by trees, stumps, tracks, pipes, ducts, timber, masonry or other obstacles; for removing, protecting, repairing, or restoring, without cost to the Owner, all pipes, ducts, drains, sewers, culverts, conduits, curbs, gutters, walks, fences, tracks, or other obstacles, road pavements and other ground surfacing whether shown on plans or not for draining, damming, pumping or otherwise handling and removing, without damage to the work or to other parties, and without needless nuisance, all water or sewage from whatever source which might affect the work or its progress, or be encountered in excavations made for the work; for maintaining uninterrupted water service, wastewater service, and temporary pumping, for providing temporary equipment, systems and facilities as specified and as necessary; for furnishing, inserting and removing all sheeting, shoring, staging, cofferdams, etc.; for all signs, fencing, lighting, watching, guarding, temporary surfacing, bridging, snow removal, etc., necessary to maintain and protect travel on streets, walks and private ways; for making all provisions necessary to maintain and protect buildings, fences, poles, trees, structures, pipes, ducts and other public or private property affected or endangered by the work; for the repair or replacement of such things if injured by neglect of such provisions for removing all surplus or rejected materials as may be directed; for replacing, repairing and maintaining the surfaces of streets, highways, public and private lands if and where disturbed by work performed under the Contract or by negligence in the performance of work under the Contract; for

furnishing the requisite filling materials in case of any deficiency or lack of suitable materials; for obtaining required permits and licenses including those identified in Section 01060 and complying with the requirements thereof, including the cost of furnishing any security needed in connection therewith; for any and all expense on account of the use of any patented device or process; for protection against inclement or cold weather; for all expenses incurred by or on account of the suspension; interruption or discontinuance of work; for the cost of the surety bond and adequate insurance; for all taxes, fees, union dues, etc., for which the Contractor may be or become liable, arising out of his operations incidental to the Contract; for providing equipment on the site and off site; for providing a field office and its appurtenances and for all general and incidental expenses; for tools, implements and equipment required to build and put into good working order all work contemplated by the Contract; for maintaining and guaranteeing the same as provided; and for fulfilling all obligations assumed by the Contractor under the Contract and its related documents.

- B. The Owner shall pay 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.
- C. The prices for those Items which involve excavation shall include compensation for disposal of surplus excavated material and handling groundwater.

1.07 PAYMENT

- A. Refer to General Conditions: Article 14 – Payments to Contractor and Completion.

1.08 METHOD OF MEASUREMENT AND BASIS OF PAYMENT

BID ITEM NO. 1 A WORCESTER ROAD SEWER PUMPING STATION REPLACEMENT

- A. The lump sum price for Item 1A shall constitute full compensation for furnishing all labor, materials, tools and equipment necessary, to reconstruct the Worcester Road Sewer Pumping Station, including but not limited to mobilization and demobilization; providing the Contractor's Health and Safety Plan; coordination with City officials, including phasing project to minimize disruption to the existing sewer system; providing all required site preparation; erosion and sedimentation control; demolition; construction of a new pump station, repairs and epoxy coating of wet well and parshall flume including up to 30 gallons of grout for infiltration mitigation, protection and reuse of the existing foundation; underground electric duct banks; protection of all existing structures and utilities; remove and replace site paving; loaming and seeding; test pits to determine depth of existing utilities; all excavation; backfill including dense grade, gravel borrow, and crushed stone; sub-grade preparation; the removal and disposal of existing equipment, including hazardous waste identified in Appendix A; temporary stockpiling of excess soil, testing of excess soil; cleaning the existing station of all debris; piping, fittings, valves and connections to existing sewer lines; pipe supports; equipment pads; pumps; instrumentation and control equipment; startup; testing and training complete as shown on the Drawings and as specified herein.

- B. Bid Item 1A shall include all cost associated with providing police details and traffic management when required to complete the work.
- C. Bid Item 1A shall include all cost for managing wastewater flows while completing permanent bypass connections.
- D. Bid Item 1A shall also constitute compensation for protection of all existing structures and utilities, all concrete work, architectural, structural, mechanical, plumbing, electrical, instrumentation, and all associated appurtenant work, as indicated on the Drawings and as specified in the Bidding and Contract Requirements and Divisions 1 through 17, except for the requirements of Bid Item 2 through Bid Item 7.
- E. Payment of the lump sum bid in the Bid Form shall be based on the approved Schedule of Values (Article 2.03 B.3 of the Standard General Conditions) and shall be considered full compensation for furnishing all labor, materials, equipment, and incidentals required, to perform the Work, in its entirety as shown on the Drawings as specified. Payment shall fully compensate the Contractor for any incidental work which is not specified or shown but which is evidently required to complete the work.

BID ITEM NO. 1 B WASTEWATER BYPASS SYSTEM EQUIPMENT RENTAL

- A. The lump sum price for Item 1B shall constitute full compensation for furnishing all equipment necessary to provide the Wastewater Bypass System required for completing all work on the Worcester Road Sewer Pumping Station, including but not limited to mobilization and demobilization; portable generators, bypass piping, bypass pumps, flow meter, fittings, control panels, alarming, Bioxide metering system including controls, and any additional appurtenances required to provide a complete wastewater bypass system.

BID ITEM NO. 1 C WASTEWATER BYPASS SYSTEM OPERATIONS AND MAINTENANCE

- A. The lump sum price for Item 1C shall constitute full compensation for furnishing all labor, materials, tools and equipment necessary to operate and maintain the Wastewater Bypass System required for completing all work on the Worcester Road Sewer Pumping Station, including but not limited to mobilization and demobilization; coordination with City officials, power costs to run the bypass pumps (electricity and diesel fuel); winterization including all materials and labor required to prevent freezing of the bypass system during winter conditions; required periodic maintenance of bypass equipment, response to alarm calls, providing qualified personnel for bypass system operation, and providing the required daily dose of Bioxide.

BID ITEM NO. 1 D INSTALLATION AND RESTORATION FOR WASTEWATER BYPASS SYSTEM

- A. The lump sum price for Item 1D shall constitute full compensation for furnishing all labor, materials, tools and equipment necessary to install, and remove the Wastewater Bypass System required for completing all work on the Worcester Road Sewer Pumping Station, including but not limited to mobilization and demobilization; coordination with City officials, including phasing project to minimize disruption to the existing sewer system; completing modifications required for suction piping connections; installation and removal of the bypass systems, and disposal of up to five (5) tons of Special Waste from post-bypass cleaning.

BID ITEM NO. 1 E DEWATERING TREATMENT SYSTEM

- A. The lump sum price for Item 1E shall constitute full compensation for furnishing all labor, materials, tools and equipment necessary to install, and remove the Dewatering Treatment System required for completing all work on the Worcester Road Sewer Pumping Station, including but not limited to mobilization and demobilization; coordination with City officials, including phasing project to minimize disruption to the existing sewer system; providing all equipment required to meet discharge requirements; and completing all discharge compliance sampling and laboratory testing.

BID ITEM NO. 2A UTILITY SERVICE ALLOWANCE

- A. The lump sum price to be paid for under Item 2A shall constitute full compensation as detailed in Section 01020 - Allowances, and not specifically paid for under other Items, as directed by the Engineer.
- B. The lump sum price allowance for this Item established in the Bid is an estimated figure to facilitate comparison of bids only. The actual amount to be paid under this Item to the Contractor will be the amount invoiced by the utility company.
- C. The lump sum price allowance for this Item shall NOT include any costs associated with Items and/or services for which specific payment Items are provided for under the Bid.
- D. If the total cost for such charges is greater or less than the allowance amount stated under this Item of the Bid, a debit or credit of the difference in such cost shall be to the Owner.

BID ITEM NO. 2B ADDITIONAL LAB TESTING SERVICE ALLOWANCE

- A. The lump sum price to be paid for under Item 2B shall constitute full compensation as detailed in Section 01020 - Allowances, and not specifically paid for under other Items, as directed by the Engineer.

- B. Allowance is specific to additional laboratory testing requested by the Owner. **All costs for testing required by the Contract Documents shall be included in the Contractor's Bid Item 1A.**
- C. The lump sum price allowance for this Item established in the Bid is an estimated figure to facilitate comparison of bids only. The actual amount to be paid under this Item to the Contractor will be the amount invoiced by the by the testing laboratory.
- D. The lump sum price allowance for this Item shall NOT include any costs associated with Items and/or services for which specific payment Items are provided for under the Bid.
- E. If the total cost for such charges is greater or less than the allowance amount stated under this Item of the Bid, a debit or credit of the difference in such cost shall be to the Owner.

BID ITEM NO. 2C

SERVICE OF UNIFORMED TRAFFIC OFFICERS

- A. Under this Item, the Contractor shall be reimbursed for certain charges for the services rendered of uniformed traffic officers to provide traffic control as specified and/or directed and authorized by the Owner/Engineer.
- B. The allowance for this Item established in the Bid is an estimated figure to facilitate the comparison of bids. The actual amount to be paid under this Item shall constitute full compensation for wages paid, premiums on workers' compensation insurance, payment on account of social security and other direct assessments on payroll, and all other costs incidental to the employment of such uniformed officers.
- C. Payment will be based on the actual PAID invoiced amount from the Police Department without allowance for mark-up, overhead or profit. A copy of the cancelled check is the required proof of payment that must be submitted in conjunction with the respective Payment Application for which reimbursement is sought.
- D. If the total cost for uniformed traffic officers is greater or less than the amount stated in the Bid, a debit or credit of the difference in cost shall be to the Owner.
- E. Payment shall be made directly to the Police department no later than the 20th day of the month following that month in which services were rendered.

BID ITEM NO. 3

ROCK EXCAVATION & DISPOSAL

CY

1. When rock is encountered, it shall be uncovered but not excavated until measurements have been made by the Engineer, unless in the opinion of the Engineer, satisfactory measurements can be made in some other manner. Blasting of rock is not allowed. Rock removal shall only be by mechanical means.
2. The quantity of rock to be paid for under Item 3 shall be the number of cubic yards of rock, measured in place before excavation, within the payment limits as specified and as defined in the details section of the Drawings, unless rock excavation beyond such limits has been authorized in writing by the Engineer, in which case, measurements shall be made to the authorized limits.
3. Excavated rock which has not been properly disposed of shall not be included for payment.

4. The bidder shall include in his bid for items involving excavation, the cost of doing the entire excavation in earth, the unit price for this Item being intended to cover the difference between the cost of rock excavation and the cost of earth excavation.
5. The unit price shall constitute full compensation for rock excavation and disposal, for all necessary backfilling, and for furnishing all additional material needed for backfilling.

BID ITEM NO. 4 GRAVEL BORROW CY

1. Gravel borrow ordered by the Engineer for backfill of trenches shall be paid for under Item 4. The quantity of gravel used as backfill for trenches shall be measured by the cubic yards to the depth and length ordered by the Engineer and to the width between payment limits for normal excavation as indicated on the Drawings. Unless otherwise directed by the Engineer gravel borrow outside the limits of normal excavation shall be furnished, placed, and compacted at the Contractor's expense, and no measurement will be made for such gravel.
2. Gravel borrow ordered to be used at other locations shall be measured after compaction and paid for under this Item as the number of cubic yards of gravel actually placed and compacted as directed.
3. Gravel borrow used to backfill rock excavations will not be measured for payment under this Item but shall be included as part of the unit price for Bid Item No. 3 - Rock Excavation and Disposal.
4. Gravel borrow used to backfill and/or fill around and/or beneath structures will not be measured for payment under this Item but shall be included as part of the lump sum price for Bid Item No. 1A Worcester Road Sewer Pumping Station Replacement.
5. The unit price shall constitute full compensation for removal of unsuitable material, furnishing, placing, and compacting gravel borrow, as specified and/or directed by the Engineer except for Rock (Bid Item No. 3).
6. Gravel borrow shall not be utilized for pavement base in disturbed areas. Dense grade crushed stone shall be provided in accordance with Specification 02500 and included as part of the lump sum price for Bid Item No. 1A Worcester Road Sewer Pumping Station Replacement.

BID ITEM NO. 5 CRUSHED STONE CY

1. Additional crushed stone used for support of existing utilities or ordered by the Engineer to be used at other locations shall be paid for under Item 5. The quantity to be paid for shall be the number of cubic yards measured in place after compaction of crushed stone within the limits directed by the Engineer.
2. Crushed stone used for bedding pipe, to backfill authorized excavations, for any drainage purpose, or as indicated on the Drawings for work for which appropriate

payment items have been provided, shall not be measured for payment under this Item.

3. Crushed stone used to backfill rock excavations will not be measured for payment under this Item but shall be included as part of the unit price for Bid Item No. 3 - Rock Excavation and Disposal.
4. Crushed stone used to backfill and/or fill around and/or beneath structures will not be measured for payment under this Item, but shall be included in the lump sum price for Bid Item No. 1A Worcester Road Sewer Pumping Station Replacement
5. The unit price shall constitute full compensation for removing unsuitable material, furnishing, placing, and compacting crushed stone, as specified and/or directed by the Engineer except for Rock (Bid Item No. 3).

BID ITEM NO. 6 CRACK REPAIR BY EPOXY INJECTION LF

1. The length of crack repair by epoxy injection to be paid for under Item 6 shall be measured by the linear foot along the horizontal projection of the centerline of the completed crack repair by epoxy injection.
2. The unit price shall constitute full compensation for furnishing and installing of the crack repair by epoxy injection including all labor, materials, and equipment for completing the work.
3. The unit price shall include all work required to prepare the concrete crack to be repaired.

SOIL TESTING, MANAGEMENT, & DISPOSAL

BID ITEM NO. 7A MANAGEMENT OF SOIL/FILL AND CONTAMINATED MATERIALS LS

1. Under Item 7A, the Contractor shall be paid for management of soil/fill and contaminated materials, as defined in Section 02080, at the lump sum price stated in the Bid Schedule.
2. The lump sum price shall constitute full compensation for furnishing all labor, materials, tools, equipment, and incidentals required for managing soil/fill and contaminated material; including segregating, handling, staging, testing, and characterization of all soil and fill material prior to final transport and disposal as well as the costs associated with characterizing the destination site as required to assess background conditions; all controls necessary to maintain compliance with regulatory requirements relative to handling contaminated soils and materials; submittal and approval of all required and specified Plans; analytical testing and characterization of all excavated soil and fill material handled; health and safety equipment; securing a staging area for stockpiling soil pending analytical testing, reuse, or disposal; protecting the stockpile areas. All costs related to transporting soils to and, if not disposed of offsite, from the staging area, if reused, shall be included for payment in this item; air monitoring; controlling the spread of airborne contaminants; all

notifications, fees, permits, and taxes; and all other requirements specified in other sections of the Contract Documents; and any other work not covered by other Bid Items.

3. The Contractor will be eligible for payment for a portion of the lump sum price based on the Schedule of Values submitted in accordance with Article 2.03 B.3 of the Standard General Conditions, as approved by the Engineer.

BID ITEM NO. 7B REMOVE AND DISPOSE BACKGROUND MATERIAL CY

1. The quantity of background material, as defined in Section 02080, to be paid for under Item 7B shall be the actual number of cubic yards of background material removed and disposed of as directed and authorized by the Engineer.
2. The unit price shall include all costs associated with the removal and disposal of background material including but not limited to labor, equipment disposal fees and furnishing the City with the appropriate material shipping record forms.
3. The Contractor will be eligible for up to 75% of the unit price when material is transported and disposed of offsite. The remaining 25% of the unit price will be paid upon the Owner's receipt of all signed transportation and disposal documents.

BID ITEM NO. 7C REMOVE AND DISPOSE IMPACTED MATERIAL TON

1. The quantity of impacted material, as defined in Section 02080, to be paid for under Item 7C shall be the actual number of tons of impacted material disposed, as measured by the calibrated scale at the receiving facility, certified by the receiving facility. If the approved facility is incapable of measuring the material by weight, the tonnage shall be determined by volumetric measurement (in cubic yards) by the Engineer and converted to tonnage based on a conversion factor of 1.4 tons per cubic yard of material.
2. The unit price shall include all costs associated with the disposal of impacted non-reportable material including but not limited to labor, equipment, transportation, disposal fees, and completing and furnishing the City with the appropriate material shipping record forms to the satisfaction of the Engineer.
3. The Contractor will be eligible for up to 75% of the bid price when material is transported to the disposal facility. The remaining 25% of the bid price will be paid upon the Owner's receipt of all satisfactorily filled and signed transportation and disposal documents.

BID ITEM NO. 7D REMOVE AND DISPOSE REGULATED – UNLINED LANDFILL MATERIAL TON

1. The quantity of regulated – unlined landfill material, as defined in Section 02080, to be paid for under Item 7D shall be the actual number of tons of regulated – unlined

landfill material disposed, as measured by the calibrated scale at the receiving facility, certified by the receiving facility.

2. The unit price shall include all costs associated with the disposal of regulated – unlined landfill material including but not limited to labor, equipment, disposal fees, transportation, and completing and furnishing the City with the appropriate bill of lading forms to the satisfaction of the Engineer.
3. The Contractor will be eligible for up to 75% of the bid price when material is transported to the disposal facility. The remaining 25% of the bid price will be paid upon the Owner’s receipt of all satisfactorily filled and signed transportation and disposal documents.

BID ITEM NO. 7E REMOVE AND DISPOSE REGULATED – LINED LANDFILL MATERIAL TON

1. The quantity of regulated – lined landfill material, as defined in Section 02080, to be paid for under Item 7E shall be the actual number of tons of regulated – lined landfill material disposed, as measured by the calibrated scale at the receiving facility, certified by the receiving facility.
2. The unit price shall include all costs associated with the disposal of regulated – lined landfill contaminated material including but not limited to labor, equipment, disposal fees, transportation, and completing and furnishing the City with the appropriate bill of lading forms to the satisfaction of the Engineer.
3. The Contractor will be eligible for up to 75% of the bid price when material is transported to the disposal facility. The remaining 25% of the bid price will be paid upon the Owner’s receipt of all satisfactorily filled and signed transportation and disposal documents.

BID ITEM NO. 7F REMOVE AND DISPOSE REGULATED – ASPHALT BATCH PLANT MATERIAL TON

1. The quantity of regulated – asphalt batch plant material, as defined in Section 02080, to be paid for under Item 7F shall be the actual number of tons of regulated – asphalt batch plant material disposed, as measured by the calibrated scale at the receiving facility, certified by the receiving facility.
2. The unit price shall include all costs associated with the disposal of regulated – asphalt batch plant contaminated material including but not limited to labor, equipment, disposal fees and furnishing the City with the appropriate bill of lading forms to the satisfaction of the Engineer.
3. The Contractor will be eligible for up to 75% of the bid price when material is transported to the disposal facility. The remaining 25% of the bid price will be paid

upon the Owner's receipt of all satisfactorily filled and signed transportation and disposal documents.

PRICE ADJUSTMENTS FOR DIESEL FUEL, GASOLINE, ASPHALT, AND CONCRETE

BID ITEM NO. 8A PRICE ADJUSTMENT FOR DIESEL FUEL

1. This adjustment will be based on fuel usage factors for various items of work developed by the Highway Research Board in Circular 158, dated July 1974. These factors will be multiplied by the quantities of work done in each item during each monthly period and further multiplied by the variance in price from the Base Price to the Period Price.
2. The Base Price of Diesel Fuel will be the price as indicated in the Bid. The Period Price will be the average of prices charged to the State, including State Tax for the bulk purchases made during each month, as published on the Massachusetts Department of Transportation's (MassDOT) website.
3. This adjustment will be applicable to excavation eligible for payment, material items furnished through the Bid, all measurements as determined by the Engineer and based on a fuel factor of 0.29 gallons per cubic yard.
4. In calculating the price adjustment for Bid Items where the Bid Item is measured and paid by the ton, the measurement shall be based on a conversion factor of 1.4 tons per cubic yard of material.
5. This adjustment will also be applicable to proposed pavement, all measurements as determined by the Engineer and based on a fuel factor of 2.90 gallons per ton.
6. This adjustment will be effected only if the variance from the Base Price is 5% or more for a monthly period. The complete adjustment will be paid in all cases with no deduction of the 5% from either upward or downward adjustments.
7. No adjustment will be paid for work done beyond the extended completion date of the Contract.
8. Any adjustment (increase or decrease) to estimated quantities made to each item at the time of final payment will have the fuel price adjustment figured at the average period price for the entire term of the project for the difference of quantity.

BID ITEM NO. 8B PRICE ADJUSTMENT FOR GASOLINE

1. This adjustment will be based on fuel usage factors for various items of work developed by the Highway Research Board in Circular 158, dated July 1974. These factors will be multiplied by the quantities of work done in each Item during each monthly period and further multiplied by the variance in price from the Base Price to the Period Price.

2. The Base Price of Gasoline will be the price as indicated in the Bid. The Period Price will be the average of prices charged to the State, including State Tax for the bulk purchases made during each month, as published on the Massachusetts Department of Transportation's (MassDOT) website.
3. This adjustment will be applicable to excavation eligible for payment, material items furnished through the Bid, and materials removed and disposed through the Bid, all measurements as determined by the Engineer and based on a fuel factor of 0.15 gallons per cubic yard.
4. In calculating the price adjustment for Bid Items measured and paid by the ton, the measurement for price adjustment shall be based on a conversion factor of 1.4 tons per cubic yard of material.
5. This adjustment will be effected only if the variance from the Base Price is 5% or more for a monthly period. The complete adjustment will be paid in all cases with no deduction of the 5% from either upward or downward adjustments.
6. No adjustment will be paid for work done beyond the extended completion date of the Contract.
7. Any adjustment (increase or decrease) to estimated quantities made to each item at the time of final payment will have the fuel price adjustment figured at the average period price for the entire term of the project for the difference of quantity.

BID ITEM NO. 8C PRICE ADJUSTMENT FOR LIQUID ASPHALT

1. The Price Adjustment will be based on the variance in price for the liquid asphalt component only from the Base Price to the Period Price. It shall not include transportation or other charges. This Price Adjustment will occur on a monthly basis.
2. The Base Price of Liquid Asphalt will be the price as indicated in the Bid. The Period Price will be the average of prices charged to the State, including State Tax for the bulk purchases made during each month, as published on the Massachusetts Department of Transportation's (MassDOT) website.
3. This adjustment will be applicable to hot mix asphalt, all measurements as determined by the Engineer by multiplying the number of tons of hot mix asphalt mixtures placed during each monthly period times the liquid asphalt content percentage times the variance in price between Base Price and Period Price of liquid asphalt.
4. The Contract Price of the hot mix asphalt mixture will be paid under the respective item in the Contract. The price adjustment, as herein provided, upwards or downwards, will be made after the work has been performed, using the monthly period price for the month during which the work was performed.

5. The Price Adjustment applies only to the actual virgin liquid asphalt content in the mixture placed on the job in accordance with the Standard Specifications for Highways and Bridges, Division III, Section M3.11.03.
6. This adjustment will be effected only if the variance from the Base Price is 5% or more for a monthly period. The complete adjustment will be paid in all cases with no deduction of the 5% from either upward or downward adjustments.
7. No adjustment will be paid for work done beyond the extended completion date of the Contract.

BID ITEM NO. 8D PRICE ADJUSTMENT FOR PORTLAND CEMENT

1. The Price Adjustment will be based on the variance in price for the Portland cement component only from the Base Price to the Period Price. It shall not include transportation or other charges.
2. The Base Price of Portland Cement will be the price as indicated in the Bid. The Period Price of Portland cement will be determined by using the latest published price, in dollars per ton (U.S.), for Portland cement (Type I) quoted for Boston, U.S.A. in the Construction Economics section of ENR Engineering News-Record magazine, and republished on the Massachusetts Department of Transportation's (MassDOT) website.
3. The price adjustment applies only to the actual Portland cement content in the mix placed on the job in accordance with the Standard Specifications for Highways and Bridges, Division III, Section M4.02.01. No adjustments will be made for any cement replacement materials such as fly ash or ground granulated blast furnace slag.
4. The Contract Price of the Portland cement concrete mix will be paid under the respective Items in the Contract. The price adjustment, as herein provided, upwards or downwards, will be made after the work has been performed, using the monthly period price for the month during which the work was performed and determined by multiplying the number of cubic yards of Portland cement concrete placed during each monthly period, as measured by the Engineer, times the Portland cement content percentage times the variance in price between the Base Price and Period Price of Portland cement.
5. This adjustment will be effected only if the variance from the Base Price is 5% or more for a monthly period. The complete adjustment will be paid in all cases with no deduction of the 5% from either upward or downward adjustments.
6. No adjustment will be paid for work done beyond the extended completion date of the Contract.

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. Access to the temporary bypass pumping system must be maintained throughout construction.
- G. After Owner occupancy of premises following substantial completion, coordinate access to site for correction of defective Work and Work not in accordance with Contract Documents, to minimize disruption of Owner's activities.
- H. 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 other work (HVAC, Plumbing, etc.)

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 other work (HVAC, Plumbing, etc.).
7. 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 Penetrations

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

THIS PAGE INTENTIONALLY LEFT BLANK

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

REGULATORY REQUIREMENTS

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. Demolition Permit – City of Framingham
 - 2. Department of Health Demolition Application – City of Framingham.
 - 3. Building Permit – City of Framingham
 - 4. Electrical Permit – City of Framingham
 - 5. Plumbing Permit – City of Framingham
 - 6. Gas Permit – City of Framingham
 - 7. Sheet Metal Permit – City of Framingham
 - 8. Excavation and Trench Safety Permit in accordance with M.G.L. c. 82A, and 520 CMR 14.00. – City of Framingham, Dept. of Public Works
- C. Route 9 is a state highway and under the jurisdiction of the Massachusetts Department of Transportation. If the Contractor's means and methods for completing the work require any work to be complete within the State Highway Layout a "Permit to Access State Highway" will be required. The Contractor shall be responsible for completing the permit application, obtaining the required permit, and payment of any fees. The Owner shall not be held responsible for any delays associated with obtaining said permit.

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 – Framingham Conservation Commission

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. Commonwealth of Massachusetts State Building Code, 780 CMR
3. Commonwealth of Massachusetts State Plumbing Code 248 CMR 10.00
4. Commonwealth of Massachusetts Electrical Code 527 CMR 12.00
5. 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

TABLE OF CONTENTS

- 1.01 American Iron and Steel
- 1.02 Suspension and Debarment
- 1.03 Statutes Regulating Construction Contracts for Public Buildings and Public Works Projects
- 1.04 Davis-Bacon Act Requirements

LIST OF ATTACHMENTS

- A - Excerpts from Massachusetts General Laws
- B - Federal Davis-Bacon Wage Rates

1.01 AMERICAN IRON AND STEEL

A. The Contractor acknowledges to and for the benefit of the City of Framingham (“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 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

1.04 Davis Bacon Act Requirements

Davis Bacon Act Requirements

The Worcester Road Pump Station Replacement project is 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.

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 <http://www.dol.gov/esa/whd/forms/wh347instr.htm> 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 <http://www.dol.gov/esa/contacts/whd/america2.htm>.

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

Federal Davis-Bacon Wage Rates

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, within the site building 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. Include the Certified Industrial Hygienist's qualifications in the submission. 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 Owner.

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 and water systems. 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. The Contractor is also responsible for reviewing site specific investigation reports included in Appendix A of these specifications.

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.

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. (WFSIS)	Federal Specification General Services Administration Specification and Consumer Information Distribution Section 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 American National Standard for Cast-Iron Pipe Flanges and Flange
250-lb. ANS 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 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 kick-off and pre-construction conferences according to Article 2 of the Standard General Conditions.

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 weekly 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.

1.04 PRE-INSTALLATION MEETINGS

- A. The Contractor will schedule pre-installation meetings for the following specification sections:
 - 1. 02149 Maintaining Existing Flow
 - 2. 04230 Placement of Reinforced Concrete Masonry
 - 3. 07270 Air Barriers
 - 4. 07454 Roofing Installation and Associated Work
 - 5. 07620 Sheet Metal Flashing and Trim
 - 6. 07841 Penetration Firestopping
 - 7. 08511 Steel Windows
 - 8. 09761 Resinous Flooring
- B. The Contractor shall provide a minimum of two weeks notice prior to scheduling a pre-installation meeting.

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.

1.02 PROGRESS SCHEDULE

- A. Refer to Section 01310 Construction Progress Schedule for Critical Path Method (CPM) construction scheduling requirements.
- B. Special attention is directed to the requirement that the Contractor shall start the Work, as specified in the General Conditions. 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 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 one (1) electronic copy through the Project's online file sharing system of all shop and working drawings for the Contract, and materials and equipment for which such drawings are specifically requested.
- B. 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 subsequent submittal(s) and the Contractor will be responsible for the cost of the review(s), 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.

- C. If resubmittals are required by the Engineer, one (1) electronic copy of the complete submittal shall again be submitted through the Projects online file sharing system.
- 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, 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. The Contractor shall submit for review and acceptance the following submittals / plans prior to the start of any construction activity. No work will be allowed to commence without the submission and acceptance of the submittals unless authorized in writing by the Engineer.
 - 1. Project Emergency Contact List
 - 2. Health and Safety Plan (Section 01069)
 - 3. Soil & Waste Management Plan (Section 02080)
 - 4. Asbestos Abatement Work Plan (Section 02082)
 - 5. Lead Based Paint Removal and Off-Site Management Work Plan (Section 02090)
 - 6. Dewatering Plan (Section 02140)
 - 7. Maintaining Existing Flow (Section 02149)
- H. 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.
- I. Until the necessary review has been made, the Contractor shall not proceed with any portion of the Work for which review is required.

- J. 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 vendors and 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 suitably numbered. Submitted shop drawings shall be accompanied by a letter of transmittal, completed by the Contractor as approved by the Engineer. Shop Drawings shall be numbered sequentially 1, 2, 3, etc. Re-submittals shall be identified by the original submittal number with an A, B, C, etc. (e.g. 1, 1A, 1B).
- K. 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.
- L. 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.
- M. 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.
- N. 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.
- O. The Contractor shall furnish additional copies of shop drawings or catalog cuts when so requested.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

NOT USED

END OF SECTION

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 using MS Project.
- B. No portion of this specification shall take precedent over the Contract Agreement.

1.02 SUBMITTALS

- A. Submit in accordance with SECTION 01300-Submittals
 - 1. Quality Assurance/Control Submittal
 - a. Version of Microsoft Project 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 a electronic color copy 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.
- B. Submit updated Construction Progress Schedule with each Pay Request.

PART 2 PRODUCTS

2.01 SOFTWARE

- A. Computer based scheduling software used by the Contractor shall be Microsoft Project.

PART 3 EXECUTION

3.01 PREPARATION

- A. General

1. The Contractor shall prepare his proposed CPM schedule based on a breakdown of work tasks and Schedule of Values 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 00700-Standard General Conditions. 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 with their Applications for Payment.
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 01381

AUDIO VIDEO RECORDING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Requirements for color audio video recording of all existing roadway and right-of-way conditions.

1.02 REQUIREMENTS

A. Pre Construction recording

1. Furnish to the Engineer an original and one copy of a continuous color audio video recording. Take recording prior to any construction activity.
2. Recordings to be of sufficient detail to accurately and clearly show the existing, preconstruction conditions of this entire area of the Work. Each recording to include an audio description of the area being video recorded.
3. Coverage shall include, but not limited to, all existing roadways, sidewalks, curbing, driveways, buildings, structures, above ground utilities, landscaping, trees, signage and other physical features located within the zone of influence of the Work. The coverage may be expanded if directed by Engineer.
4. All recordings will be done during daylight hours. No recording shall be performed if weather is not acceptable, such as rain, fog, etc.

- B. The Engineer reserves the right to reject any recordings because of poor quality.

- C. Any recordings rejected by the Engineer shall be rerecorded at no additional cost.

1.03 SUBMITTALS

- A. Provide references of similar projects for review by the Engineer, include owner contacts and telephone numbers.

1.04 QUALITY CONTROL

- A. The recording shall be performed by a qualified, established audio video recording firm knowledgeable in construction practices and inspection procedures.

PART 2 PRODUCTS

2.01 AUDIO VIDEO MEDIA

- A. Recording media shall be Digital Video Disk (DVD), single layer (4.7 GB capacity), DVD+R or DVD-R format. Contractor to ensure that recording is capable of playback on both commercial DVD players and computer DVD-ROM drives.

PART 3 EXECUTION

3.01 AUDIO AND VIDEO RECORDING

- A. Each recording shall begin with the Owner's name, Contract name and number, Contractor's name, date and location information such as street name, direction of travel, viewing side, etc.
- B. Information appearing on the recording must be continuous and run simultaneously by computer generated transparent digital information. No editing or overlaying of information at a later date will be acceptable.
- C. Digital information will be as follows:
 - 1. Day, date and time
- D. Time must be accurate to within 1/10 of a second and continuously generated.
- E. Written documentation must coincide with the information on the recording so as to make easy retrieval of locations sought for a later date.
- F. The video system shall have the capability to transfer individual frames of video electronically into hard copy prints or photographic negatives or digital image files in commonly accepted image file formats (e.g. .jpg, .tif, .etc.).
- G. Audio shall be recorded at the same time as the video recording. Special commentary will be given for unusual conditions of buildings, sidewalks and curbing, foundations, trees and shrubbery, etc.
- H. All DVD's shall bare labels with the following information:
 - 1. DVD Number
 - 2. Owner's Name
 - 3. Date of Recording
 - 4. Project Name and Number
 - 5. Location and Standing Limit of recording

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 all 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 or paid directly by the Contractor.

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 Representative and all others responsible for 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 on a T&M basis under the requirements of this Specification.

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 01510

TEMPORARY UTILITIES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Requirements for temporary utilities required during construction.

1.02 GENERAL REQUIREMENTS

- A. The Contractor is responsible for payment of all costs associated with the installation and operation of all temporary utilities necessary for the completion of the work. The Contractor shall arrange with the Engineer and Owner methods of determining monthly utility costs for Temporary Utilities prior to connection of any temporary systems. The Contractor shall pay the Owner on a monthly basis for all temporary utility costs. The Temporary Utilities to be paid by the Contractor include but are not limited to the following: Electricity, Water, Sanitary, Heating, Ventilation, Plumbing and other services required to complete the work.

1.03 TEMPORARY WATER

- A. Temporary pipelines and connections from the permanent service lines, necessary for the use of the Contractor shall be installed, protected, and maintained at the expense of the Contractor.
- B. Provide an adequate supply of drinking water from an approved source of acceptable quality, satisfactorily cooled, for his employees and those of his Subcontractors.

1.04 TEMPORARY ELECTRICITY

- A. Provide electrical energy required for temporary lighting and power.
- B. Assume all costs necessary to provide a temporary, separately metered electric service for all construction, including wastewater bypass system (see Section 02149).
- C. The Contractor shall pay for the cost of electrical energy consumed by himself.
- D. Temporary wiring of a special nature shall be paid for by the Contractor including but not limited to special circuits required by electric welders, elevators, lifts, pumps or other special equipment requiring high-amperage and/or special voltage service and exterior lighting circuits for protection against vandalism, public warning lights and lights for advertising, etc.
- E. The Contractor shall furnish all extension cords, sockets, motors, and accessories required for their work. They shall also pay for all temporary wiring of construction offices and buildings used by them.

- F. Temporary wiring installed by the Contractor shall be removed after it has served its purpose.
- G. Electrical work to be done in accordance with applicable codes.

1.05 TEMPORARY SANITARY FACILITIES

- A. Provide adequate sanitary facilities for the use of those employed on the Work. Sanitary facilities shall be made available when the first employees arrive on the site of the Work, be properly secluded from public observation, and be maintained during the progress of the Work in suitable numbers.
- B. Maintain sanitary facilities in an orderly and sanitary condition at all times and enforce their use. Rigorously prohibit the committing of nuisances on the site of the Work, on the lands of the Owner, or any adjacent property.
- C. Temporary sanitary facilities shall include hand washing with running water, liquid hand soap, and paper towel dispenser.

1.06 TEMPORARY HEATING

- A. Within 30 calendar days after the execution of this Contract, submit in writing to the Engineer for approval, three copies of method and time schedule for heating during construction which shall concur with his progress schedule submitted under Specification Section 01300. This shall include all water and wastewater pipes and appurtenances that are subject to potential freezing.
- B. The installation and operation of heating devices shall comply with all safety regulations including provisions for adequate ventilation and fire protection. Heating devices which may cause damage to finish surfaces shall not be used.
- C. After the permanent heating system has been installed, tested, and made ready for operation, the Contractor may, at his own risk and expense, use it for providing heat for protection of the Work. He shall provide and pay for all fuel and care necessary, and, when the Work is ready for acceptance, he shall, at his own expense, put the system into first-class condition, even to the extent of replacing worn or damaged parts as directed.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

NOT USED

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.
- C. Provide noise abatement measures to comply with noise levels specified in the City of Framingham's noise ordinance.

1.02 SUBMITTALS

- A. Within 30 calendar days after execution of this contract the Contractor shall submit the proposed methods for "Weather Protection". The Shop Drawing submittal shall be in accordance with Specification Section 01300.

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.

1.04 NOISE ABATEMENT

- A. Noise Abatement shall be provided to maintain sound levels within compliance of the City of Framingham Nuisance Noise Ordinance provided in Appendix F. This noise abatement shall provide adequate reduction of noise levels to maintain compliance with the sound ordinance.

- B. Furnish and install all enclosures and be responsible for all costs, including all labor, materials, and testing required to substantiate compliance with the Framingham's sound ordinance.

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 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 or 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 Contractor.

1.04 EROSION AND SEDIMENT CONTROL

- A. Erosion control and sediment control shall be done in accordance with the Order of Conditions issued by the City of Framingham Conservation Commission found in Appendix C.
- B. Plan and execute construction by methods to control surface drainage from cuts and fills, from borrow and waste disposal areas. Prevent erosion and sedimentation.
- C. Minimize amount of bare soil exposed at one time.
- D. Provide temporary measures such as berms, dikes, and drains, to prevent water flow.
- E. Construct fill and waste areas by selective placement to avoid erosive surface silts for clays.
- F. Periodically inspect earthwork to detect evidence of erosion and sedimentation; promptly apply corrective measures.
- G. Construct sediment control devices for discharge from dewatering trenches.
- H. Construct all sedimentation control devices shown on the plans.

1.05 NOISE CONTROL

- A. Noise abatement shall be provided to maintain compliance with the City of Framingham's Nuisance Noise Ordinance provided in Appendix F.
- B. Develop and maintain a noise-abatement program and enforce strict discipline over all personnel to keep noise to a minimum.

- C. 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.
- C. The Site is bordered by the Sudbury River to the west. The Contractor shall be responsible for protecting the project from flood damage.

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 within 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. Since the project is with in the City of Framingham Conservation Commission's jurisdictional area any damaged tree will be replaced at a 2:1 ratio.

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. Since the specified pre-startup operator training and post-startup services will be integrated into a plant-wide schedule, the Owner may redistribute the total number of instructor hours between pre- and post startup services.

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** copies for review. **6** 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
Chemical Metering Pumps	11300	4	4	8	4	4
Sewage Pumps	11310	8	8	16	8	8
Hoisting Equipment	14600	4	4	4	4	4
HVAC Equipment	15500	4	4	4	4	4
Variable Frequency Drives	16495	4	4	4	4	4
Engine/Generator	16612	8	4	4	4	4

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.

_____ Date: _____
(Authorized Manufacturer's Representative)

The following personnel listed below attended the training session(s):

_____ Date: _____
(Owner's Representative)

_____ Date: _____
(BETA Group, Inc. Witness)

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 new permanent equipment. The testing requirements for temporary wastewater bypass equipment is outlined in Specification Section 02149.

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.

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 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, 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 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 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 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:
 - 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.
 - F. At the end of each month and before payment for materials installed the Contractor 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.
 - G. 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.
 - H. At the completion of the contract 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 manufacturers 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

- 1. **Startup:** The initial operation of a sufficiently completed pump station by the Owner, utilizing fluid the system is intended to pump.

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 affect or be affected 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 affected and the assistance requested of the Owner.
- C. The Contractor shall, upon orders by the Engineer, startup, adjust and place in satisfactory operation all pump station equipment constructed under this Contract and shall be responsible to pay the cost of all utilities until the Engineer certifies the dates of substantial completion.
- D. At the discretion of the Engineer, individual startups may be required for various portions 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 01751 Lubricants
- E. The Contractor shall be responsible for maintaining all equipment until the dates of substantial completion.
- F. The Contractor shall assist the Owner during startup in any way deemed appropriate by the Engineer.
- G. There will be a date of substantial completion certified by the Engineer. This date 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 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 one hour 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 take precedence and only requests that do not adversely affect the flow 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 each piece of equipment that requires startup.
- B. During startup the contractor, equipment representative, electrician, Engineer, City and Woodard & Curran shall be on site.
- C. List of 24-hour "on call" representative supervisory persons

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. Worcester Road Wastewater Pumping Station)
 - 3) Common name of equipment or system (i.e. Wastewater Pumps)
- 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 an electronic copy and six (6) 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 six (6) copies. If the manual is not satisfactory, the Engineer will retain one (1) copy and return five (5) copies to the Contractor. When manuals are resubmitted, a revised electronic copy and six (6) copies will again be required. When the manual is satisfactory, except for some missing information, the Engineer may, at his option, retain all six (6) copies of the manual and request six (6) copies of the additional information and a revised electronic copy 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,
- D. The O&M shall include all as-built drawings for SCADA panels and electric panels.

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 Standard General Conditions Article 6.18, and 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: Wastewater 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 additional 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 for all construction or materials under this Contract shall be provided by the Contractor until the work is accepted by the Owner and the warranty period has started as stipulated in Articles 6 and 13 of the Standard General Conditions.
- 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 or sooner if critical to operations of the pump station.

- 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

THIS PAGE INTENTIONALLY LEFT BLANK

DIVISION 02

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 02050

DEMOLITION

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes requirements for demolition of existing facilities and removal of equipment and materials for reuse or salvage.
- B. Items scheduled for demolition are shown on the Contract Drawings.
- C. Items or areas scheduled for partial or selective demolition are shown on the Contract Drawings.
- D. Refer to Specifications Section 02080 Soil and Waste Management, Specification Section 02082 for Asbestos Abatement, and Specification Section 02090 for Lead Based Paint.

1.02 SUBMITTALS

- A. Shop Drawings
 - 1. In accordance with Specification Section 01300
- 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. Utilities
 - 1. Notify Owner to turn off affected services prior to demolition.
 - 2. Remove utilities to be abandoned as a result of demolition.
 - 3. Seal water, sewer, drainage and gas utilities and services as shown on Contract Drawings using plugs, caps or seals as needed.
 - 4. Temporary Sewer Bypass system shall be installed, started up and tested prior to any demolition work.

B. Equipment Salvage and Reuse

1. Do not remove equipment or materials without approval of Engineer.
2. Provide a minimum of one week notice for the Owner to salvage identified items.
3. Properly store and maintain equipment and materials to be reused in the Work.

3.02 SEQUENCE

- A. See Section 01800 - Maintenance.

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 wetted 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 existing piping, pumps, motors, equipment and other 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 the wastewater pump station.
- C. Floors and/or roofs, shall not be overloaded. Complete demolition on upper levels before disturbing supporting members on lower levels. Provide storing and bracing where necessary to prevent settlement or displacement of existing or new structures.

- D. On exposed surfaces, at the joint between old and new concrete, the existing concrete shall be removed to a straight rather than a rough line.
- E. Piping
 1. Remove piping to be abandoned as indicated, specified and directed by Engineer or if it interferes with new work.
 2. Remove to nearest solid support, cap and leave in place piping not indicated to be removed or interfering with new work.
 3. Piping to be removed which passes through an existing wall shall be cut off and properly capped on each side of the wall.
 4. Underground piping to be abandoned and remain shall be properly capped unless it interferes with new structures or as indicated, specified and directed by Engineer.

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. The contractor shall provide a disposal plan for approval by the Owner and Engineer. Contractor shall provide all receipts, bills of lading, manifests and other applicable documentation for any offsite disposal.
- B. All mechanical equipment, including generators, interior piping and other appurtenances indicated on the Drawings or specified and directed by Engineer to be demolished or removed will be removed from the property of the Owner immediately after disassembly and will become the property of the Contractor. The Owner reserves the right to remove any equipment or piping prior to signing of the agreement. Items identified for removal but still in use at signing of the Contract shall be salvaged by the Owner once the Contractor provides the required notice.
- C. 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 02076

ASBESTOS-CEMENT PIPE REMOVAL

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Pre-Construction Asbestos Survey Form;
- B. Daily Asbestos Project Checklist, refer to the form at the end of this Section;
- C. Waste Shipment Record (WSR) or equivalent;
- D. City of Framingham, DEP-approved template Non-Traditional Work Plan (NTWP);
- E. Framingham Department of Public Works Asbestos Cement Pipe Standard Operating Procedure (SOP), October 22, 2018 (or most recent revision).

1.02 SCOPE OF WORK

- A. Work outlined in this Section includes all work necessary for the removal, packaging, transporting, and disposing of identified or assumed asbestos-cement pipe (ACP) and asbestos-containing waste material (ACWM) specified herein, and required to complete the installation of the replacement piping as shown on the drawings. The Contractor's work shall be performed with qualified persons with appropriate worker training in accordance with MADLS Regulation 453 CMR 6.00. Alternatively, work involving the removal of non-friable, asbestos-cement pipe may be performed by workers with (minimum) MADLS-approved, 8-hour specialized OSHA Class II Asbestos Training: Asbestos-Cement Pipe (ACP) Worker Safety course.
- B. The Contractor shall inform and include the Owner in all communications with any regulatory authorities during the project or having to do with the project. This includes initial asbestos notification (ANF-001) filing and any changes to the notification (e.g., end date extensions, project closure, quantity changes, etc.).
- C. If suspect ACP is uncovered during the course of excavation, the Contractor shall cease all excavation activities and consult with the Resident Engineer and Framingham DPW before proceeding.

1.03 PROJECT DESCRIPTION

- A. The Work includes removal, packaging, transporting, and disposing ACP and ACWM, as identified herein, conducted by workers meeting the requirements of OSHA Title 29 CFR, Part 1926.1101 for Class II work. This shall include all necessary excavation to access ACP for removal.

- B. Materials, as discovered outside of those listed (either above or below), will be measured and paid or credited by unit prices to be negotiated prior to commencement of the Work. The quantities are estimates only and should be field-verified by the Contractor.
- C. The following table summarizes the locations of the Work with estimated ACP quantities. Note quantities provided below are order-of-magnitude estimates only. Refer to drawings for specific locations of known/assumed ACP.

MATERIAL TYPE	LOCATION	QUANTITY	NOTES
Asbestos-Cement Pipe Removal		Not Identified	

CY = Cubic Yards; LF = Linear Feet;

Notes:

A portion of the Work may be performed in multiple mobilizations, at different periods of time, in conjunction with other utility/road work. The Contractor shall be responsible for providing temporary water, power, heat (as needed), and trench shoring at the Site to perform the Work.

1.04 DEFINITIONS

- A. The following definitions relative to ACP abatement apply:
 1. Amended Water: Water to which a surfactant (wetting agent) has been added.
 2. Asbestos: The name given to a number of naturally-occurring, fibrous silicates. This includes the serpentine and the amphiboles forms, and includes chrysotile, amosite, crocidolite, tremolite, anthophyllite, and actinolite, or any of these forms, which have been chemically-altered.
 3. Asbestos Cement Pipe (ACP): Fiber-reinforced cement pipe where the reinforcing fibers are asbestos.
 4. Asbestos Competent Person: One who is capable of identifying existing asbestos hazards and selecting the appropriate control strategy for asbestos exposure and who has the authority to eliminate them.
 5. Asbestos-Containing Waste Material (ACWM): Any friable ACM removed during a demolition/renovation project and anything contaminated in the course of a demolition/renovation project including asbestos waste from control devices, bags or containers that previously contained asbestos, contaminated clothing, materials used to enclose the work area during the demolition/renovation operation, and demolition/renovation debris.
 6. Asbestos Notification Form (ANF-001): Official form used to notify MassDEP and MADLS prior to the start of an asbestos abatement project.
 7. Asbestos Project Designer: The MADLS-certified Asbestos Project Designer.

8. Asbestos Project Monitor: A professional capable of conducting air monitoring and analysis of schemes. This individual should be an industrial hygienist, an environmental scientist, or a Consultant with experience in asbestos air monitoring, personal protection equipment, and ACP removal procedures. This individual should have demonstrated proficiency in conducting air sample collection in accordance with OSHA Title 29 CFR, Parts 1910.1001 and 1926.1101.
9. Asbestos Supervisor: Any employee of a MADLS-licensed Asbestos Abatement Contractor who possesses a valid MADLS certification and EPA accreditation as an Asbestos Supervisor.
10. Asbestos Work Area: A regulated area, as defined by OSHA Title 29 CFR, Part 1926.1101, where asbestos abatement operations are performed, which is isolated by physical barriers to prevent the spread of asbestos dust, fibers, or debris. The regulated area shall comply with requirements of regulated areas for demarcation, access, respirators, prohibited activities, competent persons and exposure assessments and monitoring.
11. Asbestos Worker: Any employee of a MADLS-licensed Asbestos Abatement Contractor who possesses a valid MADLS certification and EPA accreditation as an Asbestos Worker, or any person who has completed a MADLS-approved, 8-hour specialized OSHA Class II Asbestos Training: Asbestos-Cement Pipe (ACP) Worker Safety course.
12. Consultant: A company, retained by the Owner, to provide services enumerated in this Section during asbestos removal activities.
13. Contractor: Company with qualified persons with appropriate worker training in accordance with: MADLS Regulation 453 CMR 6.00; or MADLS-approved, 8-hour specialized OSHA Class II Asbestos Training: Asbestos-Cement Pipe (ACP) Worker Safety course.
14. Deteriorated ACP: ACP that is crushed, flattened, or pulverized as determined by the Contractor's Asbestos Competent Person.
15. EPA: The United States Environmental Protection Agency.
16. Friable: Material that, when dry, can be crumbled, shattered, pulverized or reduced to powder by hand pressure. (310CMR 7.15)
17. HEPA Filter: High-Efficiency Particulate Air (HEPA) filter in compliance with ANSI Z9.2 1979.
18. HEPA-Vacuum Equipment: Vacuum equipment where all the air drawn into the machine is expelled through a HEPA filter with none of the air leaking past it and with a HEPA-filter as the last filtration stage.
19. MADLS: The Commonwealth of Massachusetts Department of Labor Standards.
20. MassDEP: The Commonwealth of Massachusetts Department of Environmental Protection.
21. Negative Exposure Assessment: A demonstration by the Contractor that Asbestos Worker exposure during an operation is or will be consistently below the PEL.
22. NESHAP: National Emissions Standard for Hazardous Air Pollutants regulations enforced by the EPA.

23. Non-Friable ACM: Any material that contains > 1% asbestos as determined using the method specified in EPA Title 40 CFR, Part 763, Appendix A, Subpart F, Section 1, via PLM, or is presumed to contain asbestos, that cannot be crumbled, pulverized, or reduced to powder by hand pressure (when dry).
24. OSHA: The Occupational Safety and Health Administration.
25. Owner: City of Framingham, Department of Public Works.
26. Permissible Exposure Limit (PEL): The maximum total airborne fiber concentration to which an employee is allowed to be exposed. The limit established by OSHA Title 29 CFR, Part 1926.1101 is 0.1 fibers/cc of air as an eight (8)-hour time-weighted average (TWA), and 1.0 fibers/cc of air averaged over a sampling period of thirty (30) minutes as an Excursion Limit. The Contractor shall be responsible for maintaining work areas in a manner that this standard is not exceeded.
27. RCRA: The Resource Conservation and Recovery Act (EPA Title 40 CFR, Parts 260 - 265).
28. Regulated Area: An area established by the employer to demarcate where Class II asbestos work is conducted, and any adjoining area where debris and waste from such asbestos work may accumulate.
29. Site: Property address and facility included on Asbestos Notification Form ANF-001 as required for notification of the Work.
30. Supervisor: Competent person with appropriate 8-hour specialized OSHA Class II Asbestos Training: Asbestos-Cement Pipe (ACP) Worker Safety course.
31. Surfactant: A chemical wetting agent added to water to improve penetration into ACM.
32. Survey: Any pre-demolition or pre-renovation activity undertaken at a facility for the purpose of determining the presence, location, amount, and condition of ACM or material assumed to contain asbestos. Activities including but not limited to the following do not meet the requirements for a survey pursuant to 310 CMR 7.15:
 - a. Inspections performed by employees or agents of federal, state or local government solely for the purpose of determining compliance with applicable statutes or regulations; or
 - b. Inspections, surveillance and testing conducted for the purpose of compliance with AHERA. (Per 310 CMR 7.15)
33. Temporary ACWM Storage Location (TASL): Secure, Owner controlled area located within Framingham, Massachusetts where the Contractor shall maintain a suitable covered, locked container(s), used for the storage of ACWM for 30 days or less (from project completion) prior to transportation and disposal of ACWM at final receiving facility.
34. TWA: Time-Weighted Average.

1.05 CONSULTANT

- A. The Owner shall retain a third-party, firm for the purposes of overseeing the Contractor and advising the Owner on all asbestos handling compliance requirements. The Consultant will represent the Owner during the removal project.

1.06 USE OF THE CONTRACT DOCUMENTS

- A. It shall be incumbent upon the Contractor to visit the Site and determine what exists, its condition, and what will be required to accomplish the Work intended by the Contract Documents. No increase in the Contract Sum will be permitted as a result of the Contractor's failure to visit the Site and understand the existing conditions.
- B. All work shall comply with the Contract Documents and with applicable codes, laws, regulations, and ordinances wherever applicable. The most stringent of all the foregoing shall govern the Work.
- C. It is not intended that this Section show every detail of the Work, but the Contractor shall be required to furnish, within the Contract Sum, all material and labor necessary for the completion of the Work in accordance with the intent of this Section.
- D. In case of ambiguity among the Contract Documents, the more stringent requirement, as determined by the Consultant, shall prevail.
- E. The Work includes making modifications as necessary, subject to approval by Owner in consultation with the Consultant, to correct any conflicts.
- F. All items not specifically mentioned in the Contract Documents, but implied by trade practices to complete the Work, shall be included.

1.07 SITE EXAMINATION

- A. It is understood that the Contractor has examined the Site, and reviewed information made available by Framingham DPW relating to assumed ACP, to make their own estimates of the existing conditions and difficulties attending to the execution of the Work and has based their price thereon.

1.08 CONTRACTOR QUALIFICATIONS

- A. The Contractor (including their proposed subcontractors) shall submit a record of prior experience in asbestos abatement projects, listing no less than three completed projects in the past year of similar size and scope. The Contractor shall list the experience and training of the Asbestos Supervisor (or Supervisor) and the Asbestos Abatement Workers (or Trained Workers) The information that should be included is as follows:
 - 1. Project Name and Address
 - 2. Owner's Name and Address
 - 3. Consultant's Name
 - 4. Summary of work
 - 5. Contract Amount
 - 6. Date of Completion
 - 7. Extras and Changes

- B. The Contractor selected must employ workers who have received the (at a minimum) MADLS-approved, 8-hour specialized OSHA Class II Asbestos Training: Asbestos-Cement Pipe (ACP) Worker Safety course. MADLS-certified Asbestos Workers (32-hour Asbestos Worker training) are also qualified to perform this work. At least one asbestos trained worker shall be on-site when any excavation work is being conducted.
 - 1. If the Contractor intends to use an Abatement Subcontractor, the Contractor shall ensure the Subcontractor meets all contractor requirements established herein.

1.09 ADDITIONAL GENERAL REQUIREMENTS

- A. The Contractor shall employ an Asbestos Competent Person, with experience on projects of similar scope and magnitude, who shall be responsible for all work involving ACP removal (as described in the Contract Documents and defined in applicable regulations) and have full-time, daily supervision of the Work during excavation activities.
- B. If required by federal, state, local, or any other authorities having jurisdiction over such work, the Contractor shall allow the Work of this contract to be inspected. The Contractor shall immediately notify the Owner and Consultant and shall maintain written evidence of such inspection for review by the aforementioned parties.
- C. The Contractor shall incur the cost of all fines resulting from regulatory non-compliance as issued by federal, state, and local agencies. The Contractor shall incur the cost of all work requirements mandated by federal, state, and local agencies as a result of regulatory non-compliance or negligence.
- D. The Contractor shall immediately notify the Owner and Consultant of the delivery of all permits, licenses, certificates of inspection, of approval, or of occupancy, etc., and any other such instruments required under codes by authorities having jurisdiction, regardless of who issued, and shall cause them to be displayed to the aforementioned parties for verification and recording.
- E. Contractor's storage container shall be delivered to the TASL prior to any scheduled work.

1.10 SUBMITTALS

- A. The Contractor shall submit the following Asbestos Work Plan to the Consultant, in one complete package, prior to the pre-construction meeting and at least ten (10) business days before the start of the Work:
 - 1. Submit a schedule to the Owner and the Consultant that defines a timetable for executing and completing the project, including work area preparations, removal, cleanup, decontamination, and final visual inspection.
 - 2. Submit a draft ANF to be reviewed by the City prior to submitting to DEP.

3. Submit copies of all notifications, permits, applications, licenses and like documents required by federal, state, or local regulations obtained or submitted in proper fashion.
4. Submit the name and address of the hauling contractor and the receiving facility to be used.
5. Submit a detailed, site-specific work plan including, but not limited to, work area isolation and removal methods.
6. Submit the training certificate, medical and respirator fit test records, and current, valid MADLS certification of each employee who may be on the Site (as applicable).
7. If the Contractor's Asbestos Competent Person is not conducting OSHA-required employee exposure monitoring, submit the name, address, and qualifications of the air sampling professional that the Contractor proposes to use on this project for this task. The Contractor shall note if this does not apply. Alternatively, the Contractor may submit a Negative Exposure Assessment performed within the last 12 months that documents that personnel were not exposed to asbestos levels above the established PEL.
8. Submit the name, address, and qualifications of proposed laboratories intended to be utilized for Contractor personal air sampling analysis as required by this Section (if applicable).
9. Submit detailed product information on all materials and equipment proposed for ACP removal work on this project.
10. Submit pertinent information regarding the qualifications of the Asbestos Competent Person for this project.
11. Submit a chain-of-command for the project. The chain-of-command should include the name, title, and contact number for each person listed.
12. Unless submitted as part of the Contractor's Emergency Response Plan, submit a site-specific emergency response information for the project. The emergency response information may include emergency procedures to be followed by Contractor personnel to evacuate the Site, hospital name and phone number, most direct transportation route from the Site, emergency telephone numbers, etc. If this information is contained within an Emergency Action Plan prepared by the Site's General Contractor, a copy shall be submitted for review.
13. Submit a written, site-specific Respiratory Protection Program for employees undertaking the Work, including make, model, and National Institute of Occupational Safety and Health (NIOSH) approval numbers of respirators to be used at the Site (if applicable). The Contractor shall note if the Respiratory Protection Program is not required at the Site (i.e., Negative Exposure Assessment completed within the last 12 months).
14. Submit a worker orientation plan that, at a minimum, includes a description of asbestos hazards and removal methodologies, a review of worker protection requirements, and the outline of safety procedures.

- B. No work on the Site will be allowed to begin until the Owner and the Consultant approve the Asbestos Work Plan. Any delay caused by the Contractor's refusal or inability to submit this documentation in a timely manner does not constitute a cause for change order or a time extension.
- C. The Contractor shall be responsible for submitting the abovementioned submittal requirements for subcontractors hired by the Contractor to address ACP.
- D. The Contractor shall submit the following to the Consultant during the Work:
 - 1. Copies of training, MADLS certifications, respirator fit test records, and medical records for new employees to start work 24 hours in advance of the new employee arriving at the Site (as applicable).
- E. The Contractor shall submit the following to the Consultant during the Work on a daily basis (refer to Part 4 in this Section):
 - 1. Completed Daily Asbestos Project Checklist.
 - 2. WSR completed for transport from generation site to TASL.
- F. The Contractor shall submit the following to the Consultant at the completion of the Work. The Owner reserves the right to retain payment(s) until all items are received in completion:
 - 1. Final completed copies of the WSR, signed by all transporters and the designated disposal site owner/operator within 30 days.
 - 2. Final completed copies of weight tickets, recycling tickets, and manifests for all specified materials.
 - 3. Contractor's logs (daily activity logs, daily sign in sheets, containment sign-in sheets), and all worker training, MADLS certifications, medical records, and respirator fit test records (as applicable).
 - 4. Copies of all OSHA personal air monitoring results.

1.11 REGULATIONS AND STANDARDS

- A. The Contractor shall be solely responsible for conducting this project and supervising all work in a manner that will be in conformance with all federal, state, and local regulations and guidelines pertaining to asbestos abatement. Specifically, the Contractor shall comply with the requirements of the following:
 - 1. EPA National Emissions Standards for Hazardous Air Pollutants (NESHAP) Regulations (Title 40 CFR, Part 61, Subpart M).
 - 2. EPA Asbestos Hazards Emergency Response Act (AHERA) Regulations (Title 40 CFR, Part 763, Subpart E).
 - 3. OSHA Asbestos Regulations (Title 29 CFR, Parts 1910.1001 and 1926.1101).
 - 4. Department of Transportation (DOT) Hazardous Waste Transportation Regulations (Title 49 CFR, Parts 170 - 180).

5. MassDEP Asbestos Regulations (310 CMR 7.00 and 7.15).
6. MassDEP Asbestos Cement Pipe Guidance Document, July 2019.
7. MADLS “The Removal, Containment or Encapsulation of Asbestos” Standards for Asbestos Abatement (453 CMR 6.00).
8. Life Safety Code, National Fire Protection Association (NFPA).
9. Local health and safety codes, ordinances or regulations pertaining to asbestos remediation and all national codes and standards including American Society for Testing and Materials (ASTM), American National Standards Institute (ANSI), and Underwriter’s Laboratories (UL).
10. Framingham Department of Public Works Asbestos Cement Pipe Standard Operating Procedure, October 22, 2018.

1.12 EXEMPTIONS

- A. Any deviations from the Contract Documents require the written approval and authorization from the Owner and Consultant. Any modifications from the standard work practices identified in MADLS Regulations 453 CMR 6.00, or MassDEP Regulations 310 CMR 7.15, or MassDEP Asbestos Cement Pipe Guidance Document, July 2019, must be requested in writing and approved in writing by both regulatory agencies.
- B. When conditions deviate from the conditions and work practices established herein, the Contractor shall immediately stop work.
- C. A Non-Traditional Asbestos Work Plan (NTWP) will be required if any of the following are required or occur during the project:
 1. Bulk loading of soil;
 2. Cleanup of contaminated soil stockpile; or
 3. Any other occurrence outside of the conditions and work practices described herein, or at the City of Framingham’s discretion.

Note: A template NTWP has been reviewed and approved by the MassDEP for the City of Framingham. A copy of the template will be provided if necessary. The template should be modified to be project and situation specific, and signed by the Contractor’s Asbestos Project Designer.

1.13 NOTIFICATIONS, POSTINGS, SUBMITTALS, AND PERMITS

- A. Planned Work

1. The Contractor shall make the following notifications and provide the submittals to the following agencies prior to the start of work. Submissions may be made electronically on eDEP, MassDEP's online filing system. Prior to submission, a draft copy of the notification shall be provided to the Consultant and Owner. This notification to DEP/DLS is required ten (10) calendar days prior to the start of the abatement project. The information submitted on the form must be accurate or a revision will be required.
 - a. Commonwealth of Massachusetts Department of Environmental Protection
Asbestos Program
Enforcement Division
P.O. Box 4062
Boston, MA 02211
 - b. Commonwealth of Massachusetts Department of Labor Standards
19 Staniford Street, 2nd Floor
Boston, MA 02114
2. The minimum information included in the notification to these agencies includes:
 - a. Work location/address.
 - b. Name of Supervisor (Asbestos Competent Person).
 - c. Work type (water, sewer, drain, etc.)
 - d. Amount of asbestos to be removed.
 - e. Work schedule, including proposed start and completion date.
 - f. Asbestos removal procedures to be used.
 - g. Name and location of disposal site for generated asbestos waste, residue, and debris.
3. If the ACP quantity exceeds the estimated total, a new asbestos notification (ANF-001) will be required.

B. Emergency Notification

1. The Contractor shall request and receive the Owner's approval before the Consultant files an Emergency Asbestos Notification with MassDEP on behalf of the Contractor.
2. In Consultation with the Owner, the Contractor shall adhere to the following procedures when an Emergency Asbestos Notification Form (ANF-001) is needed.
 - a. The Consultant shall contact the MassDEP Northeast Regional Office to obtain an emergency waiver number.
 - b. If no one responds at MassDEP, the Consultant shall leave a phone/email message with the following information:

- i. Work location/address;
 - ii. Contractor contact information;
 - iii. Work type (water, sewer, drain, etc.); and
 - iv. Methodology for ACP removal (reference ASBESTOS CEMENT PIPE GUIDANCE DOCUMENT, July 2019).
- c. MassDEP will issue a project specific waiver number that shall be included in the Notification (NAW#).
 - d. If no project specific waiver number is issued within 24-hours, the Contractor shall again contact the MassDEP Northeast Regional Office.
 - e. The Consultant shall provide the waiver number to the Owner and Contractor.
 - f. The Contractor shall file and provide a copy to the Owner and Consultant.

1.14 WORK SITE SAFETY PLAN

- A. The Contractor shall establish a set of emergency procedures and shall post them in a conspicuous place at the Site. The safety plan should include provisions for the following:
 1. Injured worker evacuation.
 2. Emergency and fire exit routes from all work areas.
 3. Emergency first aid treatment.
 4. Local telephone numbers for emergency services including ambulance, fire, and police.
 5. A method to notify persons on a public right-of-way, or at adjacent private properties, in the event of an emergency requiring area closures.
- B. The Contractor shall be responsible for training all workers in these procedures.

1.15 CONTRACTOR'S AIR SAMPLING RESPONSIBILITY (IF APPLICABLE)

- A. The Contractor shall independently retain an air-sampling professional or the Asbestos Competent Person shall monitor total airborne fiber concentrations in the worker breathing zones to establish conditions and work procedures for maintaining compliance with OSHA Title 29 CFR, Parts 1910.1001 and 1926.1101 (if applicable). Alternatively, a Negative Exposure Assessment completed within the last 12 months can be submitted.
- B. The Contractor's air sampling professional shall document all air sampling results and provide a report to the Owner or Consultant within 48 hours after sample collection (if applicable).
- C. All air sampling shall be conducted in accordance with methods described in OSHA Title 29 CFR, Parts 1910.1001 and 1926.1101 (if applicable).

1.16 PROPER WORKER PROTECTION

- A. This Subsection describes the equipment and procedures required for protecting workers against asbestos contamination and other workplace hazards except for respiratory protection.
- B. In accordance with OSHA Title 29 CFR, Part 1926, all workers shall receive a training course covering the dangers inherent in handling asbestos, the dangers of breathing asbestos dust, proper work procedures, and proper worker protective measures. This course must include, but is not limited to the following:
 - 1. Methods of recognizing asbestos,
 - 2. Health effects associated with asbestos,
 - 3. Relationship between smoking and asbestos in producing lung cancer,
 - 4. Nature of operations that could result in exposure to asbestos,
 - 5. Importance of and instruction in the use of necessary protective controls, practices and procedures to minimize exposure including:
 - a. Engineering controls,
 - b. Work Practices,
 - c. Respirators,
 - d. Housekeeping procedures,
 - e. Hygiene facilities,
 - f. Protective clothing,
 - g. Decontamination procedures,
 - h. Emergency procedures, and
 - i. Waste disposal procedures.
 - 6. Purpose, proper use, fitting, instructions, and limitations of respirators as required by OSHA Title 29 CFR, Part 1910.134,
 - 7. Appropriate work practices for the work,
 - 8. Requirements of medical surveillance program,
 - 9. Review of OSHA Title 29 CFR, Part 1926,
 - 10. Pressure Differential Systems,
 - 11. Work practices including hands on or on job training,
 - 12. Personal Decontamination procedures, and
 - 13. Air monitoring, personal and area.
- C. The Contractor shall provide medical examinations (as required for respirator use) for all workers who may encounter a total airborne fiber concentration of 0.1 fibers/cc or greater for an 8-hour TWA.
- D. The Contractor shall maintain control of, and be responsible for, access to all work areas to ensure the following requirements:
 - 1. Non-essential personnel are prohibited from entering the Regulated Area.
 - 2. Asbestos waste that is removed from the work area must be properly bagged and labeled in accordance with this specification Section.

3. Any materials, equipment, or supplies that are removed from the Regulated Area shall be thoroughly cleaned and decontaminated by wet-cleaning methods and/or HEPA vacuuming of all surfaces.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Deliver all materials in the original packages, containers, or bundles bearing the brand name, manufacturer name, and product technical description.
- B. The Contractor shall have a sufficient inventory of, or dated purchase orders for, materials necessary for the Work (e.g., protective clothing, respirators, respirator filter cartridges, polyethylene (poly) sheeting of proper size and thickness, tape, spray adhesive, air filters, etc.).
- C. Damaged or deteriorating materials are not permitted for use and shall be removed from the premises. Material that becomes contaminated with asbestos shall be decontaminated or disposed as ACWM.
- D. Poly sheeting (packaged in a roll to minimize the frequency of joints) shall be delivered to the Site with factory label indicating thickness.
- E. Poly disposable bags shall be 6-mil with OSHA-required pre-printed labels (OSHA Title 29 CFR, Part 1926.1101(k)(8)(iii)).
- F. Tape or adhesive spray shall be capable of sealing joints in adjacent poly sheeting, and shall be able to attach poly sheeting to finished or unfinished surfaces of dissimilar materials. Tape and adhesive spray shall also be capable of adhering under both dry and wet conditions (including use of amended water).
- G. Surfactant (wetting agent) shall consist of fifty percent (50%) polyoxyethylene ether and 50% polyoxyethylene ester, or equivalent, and shall be mixed with water to provide a concentration of 1 ounce surfactant to 5 gallons of water, or as directed by manufacturer.
- H. The Contractor shall have spray equipment capable of mixing wetting agent with water. Spray equipment shall be capable of generating sufficient pressure and volume; the hose length must reach all areas within the Regulated Area.
- I. Impermeable containers shall be used to receive and retain any asbestos-containing or contaminated materials until disposal at an acceptable disposal site. The containers shall be labeled in accordance with OSHA Title 29 CFR, Part 1926.1101(k)(8)(iii). Containers must be airtight and watertight.
- J. Labels and signs, as required by OSHA Title 29 CFR, Part 1926.1101, will be used.

2.02 TOOLS AND EQUIPMENT

- A. The Contractor shall provide all clean tools and equipment necessary for asbestos abatement activities.
- B. If required/requested by Framingham DPW, the Contractor's air monitoring professional or Asbestos Competent Person shall have air-monitoring equipment of type and quantity to monitor operations and conduct personnel exposure surveillance per OSHA requirements. The equipment shall function properly and air samples shall be calibrated with a recently calibrated (within 6 calendar months) rotameter.
- C. The Contractor shall have available sufficient inventory or dated purchase orders for materials necessary for the Work, including protective clothing, respirators, respirator filter cartridges, poly sheeting of proper size and thickness, labels, tape, spray adhesive, and air filters.
- D. The Contractor shall provide (as needed) temporary electrical power panels, electrical power cables, and/or electrical power sources (e.g., generators, etc.).
- E. The Contractor shall be responsible for coordinating electrical and water services, and shall pay for these services for the duration of the project (if applicable).
- F. The Contractor's supervisor shall perform project monitoring activities (e.g., final visual inspection(s), etc.).
- G. HEPA-Vacuum Equipment, of suitable size and capacities for the project, shall have HEPA filter(s) capable of trapping and retaining at least 99.97% of all mono-dispersed particles of 0.3 micrometers in diameter or larger.

PART 3 - EXECUTION

3.01 PRE-CONSTRUCTION MEETING

- A. Consultant to complete a Pre-Construction Asbestos Survey Form.
- B. A pre-construction meeting will be scheduled prior to the start of Work. The Contractor must attend this meeting (as required by the Owner); the assigned Asbestos Competent Person must also attend this meeting.
- C. The Contractor shall present a detailed project schedule and project submittals at the pre-construction meeting. Variations, amendments, and corrections to the presented schedule will be discussed, and the Owner and the Consultant will inform the Contractor of any scheduling adjustments for this project.
- D. Following the pre-construction meeting, the Contractor shall submit a revised schedule (if needed) no later than one week after the meeting.
- E. Review known or suspect AC locations within project.

3.02 WORK AREA PREPARATION

- A. The Contractor shall demarcate the work area by restricting access to authorized personnel.
- B. The Contractor shall expose the pipe in a manner that will minimize the risk of making it friable or releasing asbestos dust into the environment.
- C. The Contractor shall start by exposing the ACP with minimal disturbance by excavating no closer than 6 inches of the pipe.
- D. The Contractor shall carefully uncover the remainder of the soil surrounding the pipe by hand or shovel.
- E. The Contractor shall stockpile the excavated soil adjacent to the excavation in accordance with OSHA set-back requirements.
- F. The Contractor's Asbestos Competent Person shall assess the ACP to determine if it is damaged, cracked, or broken.
- G. Regardless of ACP assessment, the Contractor shall place 6-mil thick poly sheeting under the ACP to prevent soil contamination. Note that if the excavation is filled with water, the placement of poly sheeting is not required.

3.03 ACP REMOVAL PROCEDURES – INTACT ACP

- A. The Contractor shall have an Asbestos Competent Person on the Site at all times to ensure proper work practices are followed throughout the project.
- B. If a sub-contractor is retained for pre-abatement services, abatement work shall not commence until authorized by the Consultant/Owner.
- C. The Contractor shall adequately wet the full-length of exposed ACP with amended water before and during removal.
- D. The Contractor shall separate ACP at the nearest coupling (i.e., bell or compression fitting), if possible.
- E. The Contractor shall prepare the excavation for saw cutting of intact ACP. Note that if breakage or cutting of the ACP is required, the procedure in Damaged ACP section (3.05) shall be followed.
- F. Slide the ACP apart at the joints (no saw cutting) or use other methods that do not cause the pipe to break, become friable, or otherwise create the potential to release asbestos fibers.

- G. Wrap the wet ACP in two layers of 6-mil poly sheeting, seal with duct tape, and label in accordance with the requirements set forth in this Section. Note this work can be done in the excavation or adjacent to the excavated area.
- H. Sealed disposal containers, and all equipment used in the work area, shall be included in the cleanup and shall be removed from work area at an appropriate time in the cleaning sequence.
- I. At any time during asbestos removal, should the Consultant suspect contamination of areas outside the work area(s), they shall cause all abatement work to stop until the Contractor takes the necessary steps to decontaminate these areas and eliminate the causes of such contamination. Unprotected individuals shall be prohibited from entering suspected contaminated areas until air sampling and visual inspections verify decontamination.
- J. After completion of the initial final cleaning procedure, including removal of all containers, but prior to backfilling, a final visual inspection shall be conducted by the Contractor's Asbestos Competent Person or Asbestos Project Monitor. The final visual inspection shall verify that ACP and residual debris has been removed from the excavation.

3.04 ACP REMOVAL PROCEDURES – DAMAGED ACP

- A. If visible ACP debris is observed in the excavation, the Contractor shall remove it with (minimum) one inch of underlying soil and disposed of as ACWM.
 - 1. Soil must be containerized in 6-mil poly bags or drums lined with 6-mil poly. Bulk loading of soil is not permitted without MassDEP approval of a NTWP.
- B. Adequately wet full-length of exposed ACP with amended water before and during removal.
- C. Saw cutting of ACP shall only be conducted with approved wet-cutting equipment (ICS or Wachs Guillotine).
- D. Wrap wet ACP in two layers of 6-mil poly sheeting, seal with duct tape, and label.
- E. Manage wrapped ACP, poly, and any other material contaminated with visible asbestos debris as ACWM.
- F. Sealed disposal containers, and all equipment used in the work area, shall be included in the cleanup and shall be removed from work area at an appropriate time in the daily cleaning sequence.

- G. At any time during asbestos removal, should the Consultant suspect contamination of areas outside the work area(s), they shall cause all abatement work to stop until the Contractor takes the necessary steps to decontaminate these areas and eliminate the causes of such contamination. Unprotected individuals shall be prohibited from entering suspected contaminated areas until air sampling and visual inspections verify decontamination.
- H. After completion of the initial final cleaning procedure, including removal of all containers, but prior to backfilling, a final visual inspection shall be conducted by the Contractor's Asbestos Competent Person or Asbestos Project Monitor. The final visual inspection shall verify that ACP and residual debris has been removed from the excavation.

3.05 SOIL CONTAINING ACP FRAGMENTS – BEFORE LOADING

- A. If less than 3 cubic yards of soil is observed to contain ACP fragments, before it is loaded, the Contractor shall containerize the soil in 6-mil poly bags or lined drums and handle it as ACWM in accordance with this Section and SOP.
- B. If greater than 3 cubic yards of soil is observed or containerization is not feasible, the Contractor shall contact the Consultant and City of Framingham Project Manager to contact MassDEP to approve an NTWP to address the bulk loading of contaminated soil.

3.06 SOIL CONTAINING ACP FRAGMENTS – AFTER LOADING

- A. If soil is observed to contain ACP fragments after it has been loaded onto the Contractor's vehicle the Contractor shall immediately cease loading operations.
- B. The Contractor shall secure the vehicle and the soil shall be covered with poly sheeting or tarpaulin.
- C. The Contractor's Asbestos Competent Person shall inform the Consultant and City of Framingham Project Manager.
- D. Consultant shall contact MassDEP NERO to provide Emergency Notification and submit request for NTWP approval within 1 business day.
- E. The Contractor shall transport the soil to a designated TASL (at the direction of the City of Framingham Project Manager) using WSR.
- F. Soil shall be transferred directly into a form-fitted, 10-mil double lined and labeled dumpster after emergency notification provided (whether or not a live person is reached on the phone at MassDEP NERO).
- G. Transport vehicle shall be free of suspect debris and decontaminated in accordance with SOP.

- H. Once MassDEP has approved the NTWP, soil shall be handled and disposed of in accordance with that plan.

3.07 SOIL CONTAINING ACP – OFF-SITE STOCKPILE LOCATION

- A. If soil is observed to contain ACP fragments after it has been transferred to the Contractor's off-site temporary location, the Contractor shall cease operations impacting the stockpile.
- B. The Contractor shall cover the stockpile with poly sheeting or tarpaulin.
- C. The Contractor shall contact the Consultant and City of Framingham Project Manager.
- D. Stockpile shall be handled and disposed of in accordance with a MassDEP-approved NTWP.

3.08 ASBESTOS CEMENT PIPE TAPPING

- A. The Contractor shall place 6-mil poly sheeting under the ACP to prevent soil contamination.
- B. The Contractor shall adequately wet the ACP with amended water before tapping to avoid creating airborne dust.
- C. The Contractor shall dispose of any material contaminated with visible asbestos debris as ACWM.

3.09 DEWATERING

- A. If water is observed within an excavation, the Contractor shall try to pump the water out of the excavation to expose the ACP.
- B. The Contractor shall assess the condition of the ACP and determine whether it is intact or deteriorated.
- C. If ACP is intact the Contractor shall pump the water from the excavation and discharge it to the closest storm drain.
- D. If the ACP is broken or deteriorated, the Contractor shall pass the standing water (after initial pump and discharge to storm drain) through a 5-micron filter before being discharged to the closest storm drain. The filter shall then be disposed of as ACWM.

3.10 CONSULTANT'S/CONTRACTOR'S INSPECTION RESPONSIBILITIES

- A. The Contractor's Asbestos Competent Person or the Owner's Resident Engineer may conduct inspections throughout the progress of the removal project. Inspections will be conducted to document the removal work progress, as well as the Contractor's procedures and practices.

- B. The Contractor's Asbestos Competent Person or the Owner's Resident Engineer may perform the following inspections during abatement activities:
1. Pre-Commencement Inspection: If required or retained for this service, pre-commencement inspections shall be performed at the time requested by the Contractor. The Consultant shall be informed 24 hours prior to the time the inspection is needed. If deficiencies are noted during the pre-commencement inspection, the Contractor shall perform the necessary adjustments to obtain compliance.
 2. Work Area Inspections: If required or retained for this service, work area inspections shall be conducted on a daily basis, at the discretion of the Consultant. During the work inspections, the Consultant's Asbestos Project Monitor shall observe the Contractor's removal procedures, assess project progress, and, if deficiencies are noted, inform the Contractor of specific remedial activities.
- C. The Contractor's Asbestos Competent Person or the Owner's Resident Engineer shall perform the following inspections after removal activities are completed:
1. Final Visual Inspection: When removal is complete, the Contractor's Asbestos Competent Person or the Owner's Resident Engineer will conduct a final visual inspection inside each excavation. The Consultant shall be informed 24 hours prior to the time that the inspection is needed. After completion of the initial final cleaning procedure, including removal of all containers, but prior to backfilling, a final visual inspection shall be conducted by the Contractor's Asbestos Competent Person. The final visual inspection shall verify that ACP and residual debris has been removed from the excavation. If residual debris is identified during the final visual inspection, the Contractor shall re-clean the excavation to meet the "no visible, suspect dust or debris" standard.
 2. Contractor's Asbestos Supervisor shall complete Daily Asbestos Project Checklist.
 3. RE shall review completed Daily Asbestos Project Checklist.

3.11 TEMPORARY ASBESTOS STORAGE LOCATION (TASL)

- A. Unless approved by the City in advance and taken to a DLS licensed Contractor's yard, all ACP waste material shall be transported to the Owner's Temporary Asbestos Storage Location (TASL) (229 Arthur Street, Framingham, MA) using a WSR or equivalent. City PM to sign WSR prior to ACM transport to TASL.
- B. The Contractor shall provide a locked, covered, lined and labeled container for the storage of ACP waste.
- C. The Owner shall provide space at the TASL for the Contractor's waste container.

- D. The Owner will provide access to the secured TASL through the Resident Engineer or City PM.
- E. The Contractor shall be responsible for the 30-day disposal deadline and final transport to an approved disposal facility.

3.12 ASBESTOS DISPOSAL

- A. ACM and/or ACWM disposal (including supplies, rags, disposable clothing, respirator filter cartridges, etc.) shall be completed in accordance with MassDEP and EPA regulations. Waste receptacles (bags, drums, etc.) shall be labeled in accordance with the most current OSHA regulations (Title 29 CFR, Parts 1910.1001 and 1926.1101) and contain the following:

DANGER
CONTAINS ASBESTOS FIBERS
MAY CAUSE CANCER
CAUSES DAMAGE TO LUNGS
DO NOT BREATHE DUST
AVOID CREATING DUST

- B. In addition to the warning label, each individual container and/or package of ACWM shall be labeled prior to being transported off the site of generation with the following information:
 - 1. Name of the waste Generator (City of Framingham),
 - 2. Waste generation location (e.g. “in the vicinity of...”),
 - 3. Generation date.
- C. Disposal site approvals shall be obtained and accepted prior to the start of asbestos removal activities.
- D. A copy of the signed disposal authorization shall be provided to the Owner, Consultant, and any required federal, state, or local agencies.
- E. Copies of all Waste Shipment Records (WSR) shall be provided to the Owner no later than 35 calendar days from when the waste was removed from the Site for inclusion in the project file. The Contractor shall document the specific amount of waste on each WSR, portion/location of the Site building it was generated from, and the type of waste. Upon receipt of the ACM waste, the landfill operator shall sign the WSR so the quantity of asbestos debris leaving the Site and arriving at the landfill is documented for the Owner.
- F. All wash water and shower water shall be collected and filtered through a five-micron filter before discharge to a sanitary sewer with prior appropriate permitting or publicly-owned treatment works (POTW) approval. Alternately, wash and shower water can be used to moisten ACWM.

- G. All ACWM shall be transported in covered sealed vans, boxes, or dumpsters which are physically isolated from the driver by an airtight barrier. All vehicles must be properly-licensed to meet Commonwealth of Massachusetts and United State Department of Transportation (DOT) requirements.
- H. Any incident and/or accident that may result in spilling or exposure of ACWM outside the containment, on and off the property, and all related issues shall be the sole responsibility of the Contractor.

[REPLACE THIS PAGE WITH DAILY ASBESTOS PROJECT CHECKLIST]

PAGE 1

[REPLACE THIS PAGE WITH DAILY ASBESTOS PROJECT CHECKLIST]
PAGE 2

END OF SECTION

SECTION 02080

SOIL AND WASTE MANAGEMENT

PART 1 - GENERAL

1.01 QUALIFICATIONS

- A. The Contractor shall demonstrate the necessary skills, experience, training, and qualifications to conduct the work as specified herein.
- B. The Contractor shall possess all required licenses, insurance, permits and trained employees to properly execute the work as specified herein.
- C. All personnel involved in the transportation of waste from the site shall have the required skills, experience, training, and qualifications including, but not limited to, Department of Transportation (DOT) and Occupational Safety and Health Administration (OSHA) training.

1.02 EXISTING CONDITIONS

- A. The following documents are available for review and appended to these Technical Specifications.
 - 1. Hazardous Material Survey (see Appendix A)
- B. The Contractor is obligated to review existing environmental assessment reports and manage the soil and groundwater in accordance with applicable state and federal regulations.

1.03 DEFINITIONS

- A. Asphalt, Brick and Concrete (ABC): Asphalt, Brick and Concrete material that is waste from construction or found in fill material during excavation. ABC material found in clean, reusable fill may be reused onsite to the greatest extent possible. All excess ABC generated during construction shall be disposed of offsite at an appropriate, licensed facility that will accept ABC waste.
- B. Area of Excavation: For the purposes of reusing soil on-site, the *area of excavation* is considered to be the approximate area in which the soil was removed provided that area is consistent in soil strata, color, texture, geotechnical properties and has substantially similar visual and olfactory characteristics. Soil returned to the *area of excavation* shall be returned to approximately the same horizontal and vertical location from which it originated provided that it is not placed in an area that differs substantially in physical or chemical characteristics as can be observed and

- measured during excavation. Soil returned to the area of excavation shall be placed and compacted as specified in the Contract Specifications.
- C. Authorized Excavation: Earth Excavation or "Excavation" consists of removal of materials encountered to the elevations and widths indicated in the Contract Drawings, Specifications, or as directed by the Engineer.
- D. Background: (see Section 1.3.W.1)
- E. Bill of Lading (BOL): A document signed by a waste transporter or the transporter's representative and issued to a waste generator that evidences the receipt of waste to a specified disposal facility or location. BOL is typically utilized as accompanying documentation during transport of Regulated soils. Soils subject to management under 310 CMR 40.0035.
- F. Competent Person: for purposes of this Specification, the term shall mean one who is capable of identifying existing and predictable hazards in the surroundings or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them [29 CFR 1926.32(f)].
- G. Containerized Waste (as defined in 310 CMR 40.0000) means discarded oil and/or hazardous material at a site in drums, tanks, engineered impoundments, or other fabricated containers, including, without limitation:
1. discarded oil and/or hazardous material that was generated at a site as a results of manufacturing industrial, commercial or other process-related activities, and
 2. discarded oil and/or hazardous material discovered, managed, generated, or accumulated as part of a response action.
- H. Contaminated Media:
1. Contaminated Debris (as defined in 310 CMR 40.0000) means any debris that contains oil and/or hazardous material associated with a release for which notification is required by 310 CMR 40.0300 and 40.1600.
 2. Contaminated Groundwater (as defined in 310 CMR 40.0000) means groundwater containing oil and/or hazardous material at concentrations equal to or greater than a release notification threshold established by 310 CMR 40.0300 and 40.1600.
 3. Contaminated Sediments (as defined in 310 CMR 40.0000) means sediments containing oil and/or hazardous material associated with a release for which notification is required by 310 CMR 40.0300 and 40.1600.
 4. Contaminated Soil (as defined in 310 CMR 40.0000) means soil containing oil and/or hazardous material associated with a release for which notification is required by 310 CMR 40.0300 and 40.1600.
 5. Contaminated Surface Water (as defined in 310 CMR 40.0000) means surface water containing oil and/or hazardous material associated with a release for which notification is required under 310 CMR 40.0300 and 40.1600.

- I. Debris (as defined in 310 CMR 40.0000) means solid material that is a manufactured object, plant or animal matter that is intended for disposal or is otherwise no longer serving its intended use. The term shall include demolition and construction waste, hay, vegetation, and other organic and inorganic absorbent materials used to contain or absorb releases of oil and/or hazardous material. The term shall not include:
 - 1. any material for which a specific treatment standard is provided in 40 CFR Part 268, Subpart D; or
 - 2. process residuals such as smelter slag and residues from the treatment of waste, wastewater, sludges or air emission residues.
- J. Demolition and Construction Waste (as defined in 310 CMR 40.0000) means any waste materials and rubble resulting from the construction, remodeling, repair or demolition of buildings, pavement, roads or other structures. Demolition and construction waste includes, but is not limited to, concrete, bricks, lumber, masonry, road paving materials, rebar and plaster.
- K. Disposal shall mean safe and legal reuse, recycling, or disposal off the site in a manner as required to comply with all applicable statutes and regulations.
- L. Hazardous Material as defined 310 CMR 40.0006.
- M. Hazardous Waste:
 - 1. Hazardous waste as defined 310 CMR 40.0006; or
 - 2. Hazardous waste as defined in 40 CFR 261.3.
 - 3. A waste, or combination of wastes, that, because of its quantity, concentration, or physical, chemical, or infectious characteristics may:
 - a. Cause or significantly contribute to an increase in mortality or cause or significantly contribute to an increase in a serious irreversible or incapacitating reversible illness; or
 - b. Pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, disposed of, or otherwise managed.
- N. Licensed Site Professional and LSP (as defined in 310 CMR 40.0006) each means a hazardous waste site cleanup professional, as defined in M.G.L. c.21A, §19, holding a valid license issued by the Board of Registration of Hazardous Waste Site Cleanup Professionals pursuant to M.G.L. c.21A, §§19 through 19J.
- O. Liquid Waste: materials generated onsite due to work performed and are waste or excess including but not limited to collected groundwater, collected stormwater, non-aqueous phase liquids, Contractor-supplied fuels and fluids, and drummed liquids.

- P. Material Shipping Record (MSR): A document signed by a waste transporter or the transporter's representative and issued to an acceptance facility that evidences that receipt of unregulated soils or waste to a specified disposal facility or location. For the shipment of contaminated soil, urban fill, and dredge materials not subject to management under 310 CMR 40.0035.
- Q. Massachusetts Contingency Plan or MCP: 310 CMR 40.0000
- R. Natural Soils: Natural soil is defined for the purposes of the Contract as unconsolidated sand, gravel, silt and clay, and the organic material which has become part of the unconsolidated soil matrix. For this section only, soil may include broken and fragmented rock.
- S. Peat: A substance of vegetable origin, consisting of roots and fibers, moss, etc., in various stages of decomposition, and found, as a kind of turf or bog. Peat shall be considered natural soil when it is encountered in small amounts (layers 1-foot (304.8 mm) or less in thickness) and when it is impractical to separate the peat from the natural soil or urban fill strata. Otherwise, peat shall be considered a distinctive stratum.
- T. Regulated Soil: Soils requiring management in accordance with 310 CMR 40.0000, and require BOL to document transport. (see Section 1.3.W.3)
- U. Remediation Waste: as defined in 310 CMR 40.0006 means any Uncontainerized Waste, Contaminated Media, and/or Contaminated Debris that is managed pursuant to 10 CMR 40.0030. Remediation Waste does not include Containerized Waste.
- V. Solid Waste (Waste): materials generated on site due to work performed and are waste or excess, including but not limited to asphalt, brick and concrete (ABC) waste, demolition waste, decontamination waste, dredging spoils (dewatered), metal waste, plaster/drywall, plastic waste, rock, rubber waste, sediment, tar waste, trash, vegetation debris, wood waste.
- W. Soil Classification Categories: Unless specifically stated otherwise, terms used in this specification are as defined in the Massachusetts Contingency Plan (MCP), 310 CMR 40.0006. The following definitions and soil classifications apply to these specifications:
1. Background or Unregulated Soil: Any fill or natural soil material which meets the regulatory definition of "background" as defined in 310 CMR 40.0006 may be reused as common fill/ordinary borrow provided it also meets the physical requirements as specified herein and as specified in Section 02210 - Earth Excavation, Backfill, Fill and Grading. Suitable soil which does not have any evidence of contamination may be reused within the area of excavation without first performing laboratory analyses. For record keeping purposes soil/fill that meet the definition of background, shall be transported under a Material Shipping Record (MSR). Background means those levels of oil and hazardous material that would exist in the absence of an MCP Disposal Site, including both Natural Background and Anthropogenic Background. Background soil may also be re-

used off-site without restriction provided it is reused in an area where background concentrations are equal to or greater than the site-specific background determined at the off-site location in accordance with DEP Policy WSC#13-500 Similar Soils Provision Guidance (or most recent update). The Contractor is responsible for determining the background levels at the point of excavation. It is also the Contractor's responsibility to identify one or more disposal facilities/locations with background levels appropriate to receive the material to be disposed or reused. It is the Contractor's responsibility to determine these background levels in advance so as to comply with 310 CMR 40.0032(3)(b) and so as not to delay or adversely affect construction operations.

2. **Impacted:** Any soil or fill material which contains oil or hazardous materials (OHM) at concentrations greater than background levels but less than release notification thresholds established by 310 CMR 40.0300 and 40.1600. Impacted soil may be reused in the area of excavation or as fill provided it is reused in an area of equal or greater contamination and meets the physical requirements as specified herein and as specified in Section 02210 - Earth Excavation, Backfill, Fill and Grading. Impacted soils requiring off-site transportation and disposal/reuse shall be transported using a Material Shipping Record (MSR).
3. **Contaminated or Regulated Soils:** Any soil or fill material which contains oil or hazardous materials at concentrations equal to or greater than a release notification threshold established by 310 CMR 40.0300 and 40.1600, except where the presence of the material is consistent with the regulatory definition of "background" as defined in 310 CMR 40.0006.

Any soils which contain either petroleum or chemical odor or visual indications of oil or hazardous materials shall be handled as potentially contaminated soils. Soil/fill that may be contaminated shall be set aside by the Contractor for assessment by the Contractor's environmental professional (LSP) in a secure manner to prevent exposure to humans and the environment and in accordance with 310 CMR 40.0036. Soil/fill that is staged and characterized can be reused within the area of excavation or elsewhere on site provided the material has been tested and has equal or less contamination than the point where it is to be reused and it is not reused beneath a permanent structure such as a building foundation. Any excavated soil/fill material not reused within the area of excavation must be characterized prior to off-site reuse/disposal. After analytical results are available, soil/fill shall be handled in accordance with the type and degree of contamination (if any) present in the soil/fill, and recommendations of the Contractor's LSP.

Contaminated soil that cannot be reused on site shall be reused off-site, recycled, or disposed as a solid waste at an appropriately permitted facility unless it also meets the regulatory definition of hazardous waste as defined in 40 CFR Part 261 or contains detectable asbestos. Contaminated soils requiring off-site transportation and reuse/disposal or recycling shall be transported using a Material Shipping Record (MSR) or Bill of Lading (BOL), as appropriate. Subcategories of Contaminated soil are defined as follows:

- a. Unlined Landfill Material: Soils that meet all applicable criteria (i.e., COMM 97-001 and/or facility-specific permit requirements) for off-site reuse as daily cover, intermediate cover, or pre-cap contouring material at in-state unlined

landfills. Note: per COMM 97-001, sediments may not be re-used as Unlined Landfill Material.

- b. Lined Landfill Material: Soils that meet all applicable criteria (i.e., COMM 97-001 and/or facility-specific permit requirements) for off-site reuse as daily cover, intermediate cover, or pre-cap contouring material at in-state lined landfills.
 - c. Asphalt Batch Plant Material: Soils that meet all applicable criteria for recycling at an asphalt batching plant and/or the specific licensing requirements for the proposed recycling facility. Soil that does not meet the applicable COMM 97-001 criteria for Unlined or Lined Landfill Material that is characterized by the following: TPH concentrations in excess of 5,000 milligrams per kilogram (mg/kg), or total SVOC concentrations in excess of 100 mg/kg, or total non-chlorinated VOC concentrations in excess of 10 mg/kg, and total lead concentrations below 3,000 mg/kg and TCLP metal concentrations below applicable hazardous levels. Material classified as Asphalt Batch Plant Material shall be excavated and transported to an asphalt batch plant for recycling. This material cannot be used as daily cover at or disposed of at a Massachusetts Unlined or Lined Landfill.
 - d. Out-of-State Non-Hazardous: Soils that contain concentrations of contaminants that exceed in-state lined and unlined landfill reuse criteria as well as asphalt batch plant acceptance criteria, but meet the criteria for regional thermal treatment facilities or out-of-state recycling facilities, and are not classified as a Resource Conservation and Recovery Act (RCRA) Hazardous Waste.
4. Hazardous Waste: A waste, or combination of wastes, that, because of its quantity, concentration, or physical, chemical, or infectious characteristics may cause or significantly contribute to an increase in mortality or cause or significantly contribute to an increase in a serious irreversible or incapacitating reversible illness; or pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, disposed of, or otherwise managed. Also included within the definition of hazardous waste is hazardous waste as defined 310 CMR 40.0006 and 40.CFR 261.3. Hazardous waste as defined in 40 CFR 261.3 is a solid waste that exhibits any of the characteristics of hazardous waste in excess of regulation levels presented in 40 CFR 261, subpart C and/or that is listed in 40 CFR 261, subpart D; that is a mixture of solid and hazardous waste; or that is derived from a listed waste. Subcategories of Class C soils shall be as follows:
- a. Post-treatment Non-Hazardous: Soils classified as hazardous waste that have been treated on-site to reduce the toxicity characteristic (e.g., for TCLP lead).
 - b. Hazardous: Material determined to contain "listed" or "characteristic" hazardous waste constituents which cannot be readily treated on-site. This material must be transported to an out-of-state approved RCRA Subtitle C hazardous waste disposal or treatment facility under a Uniform Hazardous Waste Manifest.
- X. Special Waste: Any waste that is determined not to be a hazardous waste pursuant to 310 CMR 30.000 and that exists in such quantity or in such chemical or physical state, or any combination thereof, so that particular management controls are

required to prevent an adverse impact from the collection, transport, transfer, storage, processing, treatment or disposal of the waste. Asbestos and PCB-contaminated soils/fill are examples of special waste categories. Also refer to Specification Section 02076 – Asbestos-Cement Pipe Removal, Section 2082 Asbestos Abatement, and 02090 Lead Based Paint and Off Site Management.

- Y. Transportation Documentation or Shipping documentation means the document used to identify and accompany soil or waste during transport such as a Material Shipping Record (MSR), Bill of Lading (BOL), or Uniform Hazardous Waste Manifest. Also referred to as a shipping record.
- Z. Unauthorized Over Excavation: Consists of removal of materials beyond indicated elevations and width limits indicated in the Contract Documents without direction of the Engineer. Over-excavation material handling, transportation and disposal, backfilling and compaction shall be at the Contractor's expense. Over-excavations shall be backfilled and compacted as specified for excavations of the same class, unless otherwise directed by the Engineer.
- AA. Unauthorized Excavation: Consists of removal of materials beyond indicated sub-grade elevations or Contract-defined limits as shown in the Contract documents without specific direction of the Engineer. Unauthorized excavation, handling material, transportation and disposal, backfilling and compaction shall be at the Contractor's expense. Unauthorized excavations shall be backfilled and compacted as specified for excavations of the same class, unless otherwise directed by the Engineer.
- BB. Unknown Materials: Any material, that is not readily identifiable as nonhazardous waste, and which has not been previously characterized or encountered during site investigation activities. The Unknown Material classification is to be used in the event that an unexpected, unusual material is encountered for which special handling procedures shall be required in order to handle the material safely. Such wastes include but are not limited to:
 - 1. Unlabeled drums or containers containing material which is not readily identifiable as a non-hazardous substance.
 - 2. Any material, which varies significantly from material previously observed on site and which cannot be readily identified as a nonhazardous.
 - 3. Waste material of unusual color or odor or material with indications of hazardous levels (e.g. exceeding OSHA permissible exposure limits) of contaminants as evidenced on an organic vapor monitor or other similar instrument.

The Owner reserves the right to apply generator knowledge to classify and profile the material as a previously encountered waste or as a known waste. In the event that a material is encountered which the Contractor is uncertain as to its nature, the Owner or their representative shall assess the material with the Contractor and inform the Contractor as to the nature of the material (known or unknown).

- CC. Unregulated Soil: (see Section 1.3.W.1)

- DD. Urban Fill: Fill, also known as urban, or miscellaneous fill, is defined as a mixture of soil and other materials which have been located in the area through man-made processes primarily for the purpose of grading, backfilling or filling in low areas. Material commonly associated with urban fill includes, but are not limited to; coal, glass, brick, ash, wood fragments and other similar granular materials. Urban fill shall not include boulders, ledge, consolidated rock, asphalt, concrete, railroad timbers, rail, cobblestones or any other abandoned building materials.
- EE. Waste Manifests: the hazardous waste shipping/transportation documentation required to ship all hazardous waste and subject to provisions in 49 CFR 172 Subpart C.

1.04 DESCRIPTION OF WORK

A. General

1. This Section includes furnishing all labor, equipment, materials, and incidentals required to perform all operations in connection with the handling and disposition, stockpiling, transport, in-project reuse and/or off-site reuse or disposal of excess excavated materials resulting from the construction operations as specified. In-project reuse shall be defined as material that is reused within the Project, such as approved use of excavated soils as backfill into the excavation trench after installation of new utilities.
2. This Section includes proper handling and management of waste materials, including, but not limited to, construction debris, building demolition, municipal waste, boulders, regulated and unregulated soils, ash, rubble, asphalt, brick and concrete (ABC), asbestos containing material, asbestos cement pipe (Section 02076), hazardous materials and empty or crushed drums and/or drum parts.
3. Coordinate work with that of all other trades or contracts affecting or affected by work of this Section. Cooperate with such trades to assure the steady progress of all work under the Contract.
4. All work shall be conducted in compliance with Contractor-prepared plans as specified in Paragraph 1.07 Submittals of this Section.
5. Implementation of the submitted HASP and other applicable includes establishing work zones (e.g., support zone, contamination reduction zone, exclusion zone), preparing a decontamination pad(s) and staging area(s), performing the appropriate environmental monitoring, training and medical monitoring of personnel, coordinating waste disposal and waste characterization as needed, etc.
6. The Contractor shall develop, implement, maintain, supervise, and be responsible for all soil management practices during the course of this contract. An OSHA Competent Person, with demonstrated experience in clean and contaminated soil and hazardous waste handling (e.g. L.S.P.), shall be present during all excavation, backfilling, field screening, segregating, handling, and characterization of all soils excavated in the course of completing this contract to ensure that soil is managed in accordance with applicable laws, regulations, and this Section.
7. Demobilizing the site, including, but not limited to, removing and disposing of excess or waste soils, rock, solid waste, demolition waste, construction-related equipment and materials used for personnel and equipment decontamination and

related waste such as personal protective equipment (PPE), decontamination water/solids, temporary covers, and wash-water storage tanks; disconnection of temporary utilities; and final clean-up to pre-construction conditions.

8. The Contractor is responsible for being aware of potential hazards at the site and reviewing all existing information which provides evidence of contamination within the limit of the work.

B. Soil and Waste Management

1. This Section describes the general parameters and requirements for testing (including field screening and laboratory chemical analysis), excavation, handling, storage, tracking, transport, and in-project reuse or off-site reuse/disposal of soils.
2. In the course of the work, it may be necessary to excavate and handle potentially contaminated soil or hazardous material. The soil or hazardous materials management practices specified herein apply to all soil and/or hazardous materials excavated during the course of this Contract. Contaminated soils and hazardous materials/hazardous waste shall be managed in accordance with 310 CMR 40.0000 and 310 CMR 30.000.
3. The Contractor shall segregate soils during excavation and stockpiling to avoid mixing soils (i.e. topsoil, fill and natural soils shall be segregated, in addition to regulated, unregulated soils, etc.).
4. Characterization of soil, and unknown material for disposal/off-site reuse purposes; field screening and soil management/segregation; temporary storage/staging; and characterization (as may be necessary for unknown materials and/or for compliance with receiving facility requirements); and disposal and/or off-site reuse of excavated soil and waste material. All laboratory chemical analyses conducted shall utilize currently accepted U.S. EPA and applicable state agency analytical protocols and procedures.
5. The Contractor shall characterize all excavated and stockpiled soil and fill material prior to off-site reuse or disposal. Characterization requirements may vary depending on the source/location of the excavated soil/fill, the site selected to receive soil suitable for off-site reuse, or the disposal facility permits and policies. The Contractor is responsible for final waste characterization and shall determine if any additional waste characterization is required at no additional cost to the Owner.
6. Providing and constructing a secure soil staging area sized to adequately segregate soils in accordance with the conditions specified without impeding construction-related activities. The Contractor is to use existing information and obtain additional information as may be needed to minimize the need for a staging area. If a staging area is required to characterize unknown or excess material for any reason, the Contractor is responsible for locating, selecting, preparing and securing the area.
7. Excavated soil/fill that is contaminated or may be suspected as contaminated or containing hazardous materials shall be stockpiled and covered prior to characterization and off-site reuse or disposal. Since individual disposal facilities will have different permit conditions and specific pre-characterization data requirements the Contractor is responsible for final soil characterization prior to

transport and disposal. The Contractor is hereby made aware that for the purposes of disposal, final soil characterization is the responsibility of the Contractor and costs for securing a staging area and conducting waste characterization shall be incorporated into the Contractor's bid price for construction.

8. During construction activities, excavated soil/fill waste shall be field-screened by the Contractor and either loaded directly for off-site disposal (provided the excavated material is consistent with previously conducted investigations) or stockpiled in a soil/fill waste staging area located by the Contractor and approved by the Owner and Engineer. Stockpiles of soils shall be minimized to reduce the amount of waste material stored onsite. Stockpiled materials that are to be disposed of shall remain onsite for only as long as it would reasonably take to characterize (if not done in advance), load and transport offsite to an approved disposal facility. Soils that are to be re-used as fill material shall be stockpiled and maintained per Section 3.04 Staging Areas.
9. Soil suspected of having the characteristics of a hazardous waste or of containing a listed hazardous waste shall not be removed from the excavation except at the direction of the Engineer.
10. Soil/fill waste shall not be staged within 100 feet (30.5 meters) of a reservoir, wetland or Area of Critical Environmental Concern or in a 100-year floodplain. Soil/fill waste shall not be staged in the work area over night. Contaminated material requiring additional waste characterization due to waste disposal facility requirements or in order to assess unknown materials, shall be staged securely pending analytical sampling and characterization by the Contractor.
11. The Contractor shall reuse excavated soil at the point of origin to the maximum degree possible. Soil/fill which cannot be reused immediately at the point of origin shall either have been pre-characterized for off-site reuse or disposal by the Contractor and directly loaded for off-site transport (provided the excavated soil/fill is consistent in visual, olfactory and field screening characteristics with subsurface investigation conducted prior to construction pursuant to the MCP) or it shall be staged at a location determined and secured by the Contractor pending analytical characterization.
12. Excavating soil, fill and waste containing potential asbestos-containing material (e.g., transite board) shall conform to SECTION 02076 ASBESTOS CEMENT PIPE REMOVAL. No off-site staging of asbestos materials or asbestos containing soils shall be allowed except at the direction of the Owner.
13. Removing characterized on-site materials for off-site re-use or disposal.
14. Placing and grading of certified clean fill (including fill from on-site which is determined to be suitable for re-use). The Contractor is to maximize the in-project reuse of on-site materials by using soil suitable for such reuse prior to importing material on site.
15. In the event that a previously uncharacterized, unknown material is encountered the Contractor shall manage the material separately and will temporarily stage the material pending characterization as specified herein.
16. All Investigation Derived Wastes are the property and responsibility of the Contractor and are to be disposed of by the Contractor under a Uniform Hazardous Waste Manifest, Material Shipping Record or by a Bill of Lading, as appropriate. The parties understand and agree that any consultant or sub-consultant (at any tier) is not, and has no responsibility as, a generator, treater,

storer, transporter, or disposer of hazardous or toxic substances found or identified at the project site, and that the Contractor agrees to assume responsibility for and indemnify and hold any consultant or sub-consultant (at any tier) harmless from the foregoing.

C. Groundwater Management

1. Management of contaminated groundwater: If groundwater potentially impacted by oil and/or hazardous material (OHM), based on visual or olfactory evidence, is encountered in the course of the work, construction dewatering and discharge permits and groundwater treatment may be necessary depending upon the discharge method(s) and/or location(s) utilized by the Contractor. The Owner and Engineer shall be notified by the Contractor if groundwater potentially impacted by OHM is identified. REFER TO SECTION 02140 DEWATERING.

1.05 RELATED WORK

- A. Section 01025 - Measurement and Payment
- B. Section 01069 - Health and Safety Requirements
- C. Section 01560 - Temporary Controls
- D. Section 02050 - Demolition
- E. Section 02076 - Asbestos Cement Pipe Removal
- F. Section 02082 - Asbestos Abatement
- G. Section 02090 - Lead Based Paint and Off-Site Management.
- H. Section 02140 - Dewatering
- I. Section 02200 - Earth Excavation, Backfill, Fill and Grading

1.06 REFERENCES

- A. All work at the site must be performed in accordance with all applicable federal, state, and local regulations, permits and licenses. Comply with applicable requirements of the following standards and those referenced in this Section. Where these standards conflict with other specified requirements, the most restrictive requirements shall govern.
- B. OSHA regulations (including, but not limited to, 29 CFR 1910.1000, 29 CFR 1926, and CFR 1910.120), 40-hour Occupational Safety and Health Administration (OSHA) training (plus 8-hour refresher training) and all other applicable state and federal regulations regarding health and safety requirements;
- C. The applicable parts of the Code of Federal Regulation (CFR) Title 40: Protection of Environment, pertaining to the Comprehensive Environmental Response and Liability Act (CERCLA) and the Superfund Amendments and Reauthorization Act (SARA), RCRA, and the National Emission Standards for Hazardous Air Pollutants (NESHAPS) as regulated by the U.S. Environmental Protection Agency (U.S. EPA);
- D. Massachusetts Site Assignment Regulations for Solid Waste Facility Regulations 310 CMR 16.000.

- E. Massachusetts Solid Waste Management Facility Regulations 310 CMR 19.00.
- F. State regulations specified in the Massachusetts Contingency Plan (MCP) (310 CMR 40.0000), and Massachusetts General Law 21E - Massachusetts Oil and Hazardous Materials Release Prevention and Response Act, and applicable Massachusetts Department of Environmental Protection (MassDEP) guidelines and policies;
 - 1. Massachusetts Department of Environmental Protection, Bureau of Waste Site Cleanup Policy No. WSC-94-400 entitled "Interim Remediation Waste Management Policy for Petroleum Contaminated Soils," dated April 21, 1994.
 - 2. Massachusetts Department of Environmental Protection Bureau of Waste Prevention Policy No. COMM-97-001 entitled "Reuse and Disposal of Contaminated Soils at Massachusetts Landfills," dated August 15, 1997.
 - 3. Massachusetts Department of Environmental Protection, Bureau of Waste Prevention Policy No. WSC#-13-500 "Similar Soils Provision Guidance," dated September 4, 2013.
 - 4. Massachusetts Department of Environmental Protection, Policy #COMM-15-01 "Interim Policy on the Re-Use of Soil for Large Reclamation Projects," dated August 28, 2015.
 - 5. MassDEP Technical Update. Background Levels of Polycyclic Aromatic Hydrocarbons and Metals in Soil (2002);
- G. Department of Transportation (DOT) regulations 49 CFR, and state transportation licenses and permits;
- H. NIOSH/OSHA/USCG/EPA: "Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities" October 1985, DHHS (NIOSH). Publ. No. 85-115;
- I. Department of Transportation training;
- J. U.S. Army Corps of Engineers 404 permit;
- K. Contractor's license;
- L. National Pollutant Discharge Elimination System (NPDES) Notice of Intent (NOI) to discharge and associated general permits;
- M. Massachusetts Water Resources Authority pretreatment and construction dewatering requirements and permits;
- N. Excavation and/or grading permits;
- O. Special use permits;
- P. Special waste haulers certificate;

- Q. Massachusetts Wetlands Protection Act and associated Order of Conditions;
- R. City of Framingham wetland regulations and bylaws; and,
- S. The Contractor's Soil and Waste Management Plan (SWMP) and Health and Safety Plan to protect the workers and the public.

1.07 SUBMITTALS

- A. The Contractor shall prepare a Work Plan that generally describes the work to be performed under 02080 Part 3 (Execution). The work plan shall include, but not be limited to detailing the submittal and implementation of the following:
 - 1. Soil and Waste Management Plan;
 - a. Dust, Vapor and Odor Control Plan;
 - b. Air Monitoring Plan;
 - c. Equipment and Personnel Decontamination Plan
 - 2. Site-Specific Health and Safety Plan (See Section 01069);
 - 3. Dewatering Plan (See Section 02140);
 - 4. Stormwater Handling Plan;
 - 5. Spill and Discharge Control Plan;
 - 6. Asbestos Management Plan (See Section 02076); and
 - 7. MCP required reports as necessary will be prepared by the Engineer (RAM, URAM, status reports, closure reports).

The Soil and Waste Management Plan (S/WMP) shall be submitted at least three weeks prior to the beginning of any intrusive work at the site. Intrusive work shall not proceed prior to the S/WMP has been approved by the Owner and Engineer. All other required plans shall be submitted to the Owner or Engineer and/or their representative for review and approval at least two weeks prior to beginning any intrusive work at the site. Plans shall be consolidated provided the requirements of each plan are fully incorporated therein.

- B. Soil and Waste Management Plan (S/WMP): The S/WMP shall outline measures for sampling, field screening, laboratory analysis, and disposal/ off-site reuse of soils and wastes generated at the Project site. At a minimum, this plan shall address the following:
 - 1. Methods, procedures, and equipment used for excavating, characterizing, segregating, reusing/backfilling, loading, and transporting contaminated soil/solid waste materials encountered during excavation operations;
 - 2. A list of all transporters and receiving facilities, complete with license numbers, permit numbers (as appropriate), contact person, and address and telephone number that the Contractor utilizes for soil management and waste disposal. In addition, a copy of a memorandum of understanding between the Contractor and each disposal facility shall be attached to the Soil and Waste Management Plan. The memorandum of understanding shall detail that the disposal facility agrees to accept a specified quantity of waste as characterized in the contract specifications and detail what if any restrictions may apply. The Contractor shall provide copies of the permits held by each disposal facility which the Contractor plans to use to

- dispose of non-hazardous solid waste, hazardous waste, PCB-impacted waste and asbestos-containing waste. The transporters shall have adequate financial insurance and liability insurance mechanisms to handle any accidents, and associated third-party compensation;
3. A summary of the history of compliance actions for each receiving facility proposed to be used by the Contractor. The compliance history shall include a comprehensive list of any state or federal citations, notices of non-compliance, consent decrees or violations relative to the management of waste (including remediation waste) at the facility. The Owner reserves the right to reject any facility on the basis of poor compliance history;
 4. If hazardous wastes are to be transported, Contractor shall have or obtain a valid EPA identification number to transport hazardous materials and any other permits or licenses as required by federal, state and local laws, regulations, ordinances and procedures.
 5. Procedures for securing the staging area, controlling dust and soil/solid waste migration, preventing damage to uncontaminated areas via contaminant migration and for decontaminating vehicles and personnel exiting the staging area;
 6. The means and methods for decontaminating all equipment and personnel, including provisions for installing an equipment decontamination pad if required or specified.
 7. Means, methods and equipment for locating and protecting stockpiles.
 8. Methods and procedures for identifying stockpiled material (e.g., labeling, marking containers) and procedures for identification and tracking;
 9. Methods, procedures, and equipment used for obtaining the necessary information needed to satisfy the off-site reuse/disposal facility requirements specified herein and/or by the facility;
 10. Methods, procedures, and equipment proposed for assessing and handling Unknown Materials. The S/WMP shall indicate which laboratory(ies) the Contractor shall utilize for analytical testing of soil, groundwater and unknown materials.
 - a. An Unknown Materials information sheet shall be developed as part of the Contractor's S/WMP, upon which the Contractor shall record information such as container type, size, and condition; and, any identifying characteristics of the unknown material. The format of the information sheet shall be as accepted by the Owner and/or its representatives;
 - b. The Contractor's plan for notifying the Owner and Engineer in the event that an unknown material as defined in this specification is encountered. The plan shall include the phone numbers and names of the Owner's representative(s) that the Contractor would contact in such an event.
 11. Provisions for separation of incompatible materials and segregation of different class of soil;
 12. Procedures for consolidating (i.e., bulking) compatible materials for disposal.
 13. Procedures for dewatering as well as handling, characterization, storing, treating and disposing of groundwater due to dewatering. Refer to Section 02140 – Dewatering.
 14. Procedures for diverting and handling site stormwater. This would include handling, treatment and discharge of storm water.

15. Provisions, procedures and equipment used for control of dust, vapor and odor; including measures to control objectionable dust, vapors, and odors originating from the site (Section 3.07). This shall describe procedures to minimize the creation of dust, and the control of objectionable vapors and odors originating from the site.
 16. Provisions, procedures and equipment used to monitor air at the site (Section 3.6). This shall include site specific monitoring for potential hazards in the air; including the proposed instrument(s) to be used, the expected hazards (e.g., dust, VOCs), the monitoring frequency, the monitoring locations, and the reporting procedures.
- C. Soil Management/Tracking Documentation: Prior to off-site disposal or reuse, the Contractor shall provide to the Engineer a letter from the disposal facility indicating that the facility has reviewed the available data relative to the soil/solid waste to be delivered and agrees that the soil/solid waste meets their acceptance criteria. The letter shall be signed by a duly authorized representative of the receiving facility. Within the time constraints established in state and/or Federal laws and regulations, the Contractor shall submit to appropriate authority(ies) and the Owner, as applicable, Uniform Hazardous Waste Manifests, Material Shipping Records, and/or Bills of Lading (collectively referred to as transportation documentation) for all soils, rock, ACB, asbestos pipe, asbestos containing materials (ACM), hazardous waste and waste disposed or reused of off-site utilizing such documents. Copies of all transportation documentation and all other documents used to track and/or permit off-site transportation of soils or wastes shall be submitted to the Owner and Engineer within ten (10) days of shipment. All transportation documentation shall be signed by the transporter and receiving/disposal facility. The Contractor is responsible for preparation of all transportation documentation, manifests, Bills of Lading, Material Shipping Records, and all other related documents completely and accurately prior to submitting them to the Owner and/or its representative for generator and LSP signatures. The Contractor shall be responsible for submitting to the Owner's LSP all information necessary for preparation of LSP opinion letters to disposal facilities and coordinating disposal documentation with all parties. The Owner's LSP and the Owner shall the sign any MassDEP Bill of Lading forms where required only after the Contractor has provided the information required for preparation of electronic MassDEP forms. The Contractor shall be responsible for paying for any and all fines associated with inaccurate, incorrect, or improperly completed transportation documentation and all other related documents, including fines resulting from late or untimely submittals.
- D. Stormwater Handling Plan
1. The Stormwater handling plan shall provide provisions to ensure compliance with Section 3.10, other portions of the Contract Documents, and all applicable local, state and federal permits.
- E. Quality Control Plan

1. The Contractor shall prepare a Quality Control plan for the development, implementation, and maintenance of a quality control system to ensure that the specified quality is achieved for all materials and work performed.
- F. Spill and Discharge Control Plan (SDCP): The SDCP shall provide contingency measures and reporting responsibilities for potential uncontrolled spills and discharges of contaminated and/or hazardous materials, including, but not limited to: fuels, oils, contaminated groundwater, granular solid waste, leachate, decontamination water, sewage, and other on-site waste materials. In addition to the above listed items, the SDCP shall specifically contain: procedures for containing dry and liquid spills; absorbent material available on site; storage of spilled materials; governmental reporting (i.e., notification) procedures; decontamination procedures; discharges of sanitary or combined sewers into storm drains either by flow handling/bypassing or accidental or unintentional discharge; and procedures for protecting wetlands and surrounding public and private property.

The Spill and Discharge Plan shall indicate the location and quantity of the materials to be staged on site and the basis for the quantities (i.e. indicate the vessel which will be on site containing the greatest volume of oil or hazardous materials). No fuel or oil tanks or drums may be temporarily staged on site unless they are stored within a secondary containment system. Fuel deliveries shall be performed in a designated area which has either secondary spill containment or an impervious surface with absorbent berms located around the point of fuel delivery. The Spill and Discharge Plan shall indicate the location of the fueling area and the nature of secondary containment which the Contractor intends on utilizing.

1. Notification Procedures: The Contractor shall prepare in advance of work activities a notification list, complete with phone numbers, addresses, and contact names for all parties to be notified in the event of a spill. This list shall be posted on-site at all times and shall include:
 - a. Owner's designated representatives;
 - b. Owner;
 - c. Fire Department;
 - d. Engineer;
 - e. Massachusetts Department of Environmental Protection (as required per 310 CMR 40.0000). The Owner shall be notified immediately of an uncontrolled spill or discharge. If human health or the environment are potentially threatened, the Contractor shall take immediate action to abate the conditions and notify emergency personnel;
 - f. Appropriate emergency personnel.
2. Spill Incident Report(s): In the event of an uncontrolled spill or discharge, a written report detailing each uncontrolled spill or discharge shall include, at a minimum, the cause and resolution of incident, outside agencies involved, and date and time of occurrence. The report shall be submitted to the Owner within 48 hours of the incident. The Contractor shall document all spills on the as-built Drawings and submit the Drawings to the Owner at project completion. The Contractor shall be responsible for remediating any spills or releases of oil or hazardous materials as a result of the Contractor's activities. The site shall be remediated to pre-release conditions at no additional cost to the Owner.

- G. Medical surveillance records, OSHA 40-hour training forms, accident forms, and all other documentation requirements of the Contractor's safety and health program for personnel working on the site (who are subject to exposure to potentially contaminated soil) shall be up-to-date and kept on file at the site. The Contractor shall provide documentation of employee status upon request of the Engineer and/or their representative.

PART 2 - PRODUCTS

2.01 DUST CONTROL

- A. Dust suppression may be achieved by applying controlled amounts of water or dust suppression chemicals to the project site, and through covering of soil stockpiles, etc. Dust suppression shall be carried out in accordance with the approved SWMP.

2.02 SPILL CONTROL

- A. At a minimum, the Contractor shall maintain on-site absorbent pads, booms and absorbent materials in sufficient quantity to address a release of fuel oil, hydraulic oil or other OHM that the Contractor intends to use or store on site, including fuel oil and hydraulic oil that is used within earth moving equipment. The quantity of spill containment materials maintained on site shall be sufficient to respond to a catastrophic release from the vessel containing the greatest quantity of oil or hazardous material on-site.

2.03 SOIL MANAGEMENT/TRACKING DOCUMENTATION

- A. Provide completed Bills of Lading (BOLs), Material Shipping Records (MSRs), manifests, certificates of disposal, weight slips and all other documentation relative to disposal, reuse, treatment, recycling or other means of off-site use of soil and waste materials.
- B. Provide appropriate equipment and materials to protect and delineate stockpiles as necessary.

PART 3 - EXECUTION

3.01 GENERAL

- A. All work in this section will be performed in accordance with the Contractor's Work Plan, S/WMP, Site-Specific HASP and any other site specific plans/reports that have been approved by the Owner and Engineer.
- B. The primary concern of the Contractor in the excavating, handling, sampling, bulking, and on-site storage of soil/solid waste and/or drummed material (if encountered) will be to protect the health and safety of the site workers, the public, and the environment.
- C. The Contractor shall keep a copy of the Health and Safety Plan (HASP) on site during all operations and shall conduct daily health and safety meetings. Failure to

keep a copy of the HASP on-site, or any other breach of the Contractor's Plan, may be cause for stopping work at the cost of the Contractor. Delays caused by the Contractor's failure to comply with the health and safety regulations or any health and safety plan shall not entitle the Contractor to recover any additional costs or time lost. The Contractor shall not be allowed to resume activities until corrective measures are accepted by the Engineer and/or their representative and implemented.

- D. The Contractor shall reuse geotechnically suitable excavated material prior to using imported backfill to reduce the volume of material to be reused/disposed off-site. Imported backfill shall be used only as accepted by the Engineer. Urban fill soils and roadway base/subbase shall be re-used to the maximum extent before reusing naturally occurring soils. If off-site disposal is required, natural soils shall be preferentially disposed or reused. Contamination shall not be exacerbated as a result work activities.

3.02 SOIL/FILL WASTE CHARACTERIZATION

- A. Soil and fill material shall be classified based on the criteria established in the accepted SWMP.
 - 1. Initial Characterization of Soil/Fill Waste Material: A summary of existing conditions and investigation findings performed by the Engineer during design, including a summary of analytical results, shall be available to the Contractor.
 - 2. The Contractor shall review all the existing conditions information supplied by others. The Contractor shall use the information and shall either perform independent sampling and characterization of soil/fill waste strata to be encountered during construction in advance of excavation such that excavated soil or wastes can be segregated and directly transported to an appropriate facility or the Contractor shall make the necessary arrangements to secure a staging area(s) suitable for storing soil stockpiles or wastes pending analyses, at no additional cost to the Owner. No staging of asbestos materials or asbestos containing soils shall be allowed except at the direction of the Owner. The Contractor shall identify known or suspected areas where hazardous materials may be encountered, including but not limited to asbestos, PCB, lead-based paint.
 - 3. Soil shall be preliminarily segregated based on the Soil Classification Categories detailed in Section 1., except as indicated below.
 - a. Potential Asbestos Containing Material (PACM). If soil/fill waste suspected of containing asbestos is encountered during excavation, the Contractor shall immediately contact the Engineer to discuss the nature and extent of the PACM and to assess potential hazards and appropriate handling procedures. Prior to handling and removing the PACM, MassDEP shall be contacted for approval. Discovery and management of PACM shall be documented in the S/WMP. Evidence of PACM includes but is not limited to the presence of suspect asbestos-containing building debris such as cementitious (transite) piping, vinyl floor tiling, roofing paper or paper-like insulation materials or any other suspect asbestos containing material observed in the soil/fill waste. Following MassDEP approval, such soil/fill waste shall be segregated and

stockpiled pending confirmatory analysis to determine appropriate disposal requirements.

- b. Unknown Material. If unknown material is encountered during excavation, the Contractor shall immediately contact the Owner and Owner's representative to discuss the nature and extent of the unknown material and to assess potential hazards and appropriate handling procedures. Prior to handling and removing the unknown material from the excavation area, the Contractor and Owner and/or its representatives, shall visually assess the material and its potential hazards. Drums shall be assessed to determine whether they are leaking, corroded, pitted, bulging (evidence of reactive waste), crushed, empty, filled-in-place. Crushed, empty, and/or skeletal parts of drums shall be handled as solid waste, as specified. Note any evidence of staining or olfactory indications of contamination. The Contractor shall record any identification or markings on the drummed material(s). Discovery and management of unknown materials shall be documented as required in the SWMP.

4. Final Waste Characterization: Final waste characterization shall be the responsibility of the Contractor. The Contractor shall be responsible for determining the characterization requirements of each disposal facility in advance to facilitate timely off-site removal and to adequately estimate the disposal costs. The Contractor shall perform additional segregation based on disposal requirements. Disposal or off-site reuse of the material shall depend on sampling and characterization analytical results. At the request of the Engineer or Owner, the Contractor shall provide a split sample. The Contractor shall perform or observe all sampling and shall provide notice in advance to the Engineer so that the Engineer may observe the sampling procedure.
- B. Stockpiles within the staging area shall be sampled and characterized within a timely manner so as not to impede construction activities or preclude the reuse of soil/fill on site. If soil/fill cannot be reused on site due to the Contractor's delay in sampling material, the Contractor shall dispose of the soil/fill at no additional cost to the Owner including the additional cost of imported fill material used in its place to meet project requirements.

3.03 SOIL/SOLIDS WASTE MANAGEMENT

- A. The Contractor shall reuse, recycle or dispose of all excess soil and wastes resulting from excavation activities in accordance with federal, state and local regulations and these specifications, as well as all other state laws through which the waste material is being transported.
- B. The Contractor shall obtain receipts of disposal for disposed wastes as applicable.
- C. The Contractor shall be responsible for preparing and keeping in proper order all waste manifests, BOLs, MSRs, and shall designate one person who shall be made available to sign all transportation documentation. The Contractor shall be responsible for obtaining the generator's signature and all other signatures required

- for the proper completion of the transportation documentation. The Contractor shall allow a minimum of five (5) working days from the date of the submittal for any documents requiring the signature of the Owner and/or the LSP. The transportation documentation shall document the handling of the excess excavated soil or waste from the time it is generated until the time it is properly reused or disposed.
- D. The Contractor shall be responsible for obtaining all federal, state, and local permits and variances to allow transport of materials and wastes on public roadways.
 - E. Transportation of wastes shall be in compliance with any relevant federal, state and local requirements, and such as to assure that waste material is not released during transit.
 - F. Soil and fill material that is managed under a Utility-Related Abatement Measure (URAM) Plan pursuant to the MCP, and which is staged off-site may be re-used within fourteen (14) calendar days of excavation. Any material which is suitable for re-use as ordinary borrow, based on analytical results and could have been placed on site, but was not, due to Contractor delay (i.e. analytical results were not available within 10 days following excavation) will be disposed in accordance with the applicable regulations by the Contractor at no cost to the Owner.
 - G. Soil and fill material that is managed under a URAM Plan pursuant to the MCP, which is staged off-site and which is determined at the staging area to be characteristically hazardous may be treated (stabilized) within the “Area of Contamination” only and must be reused within 14 days or disposed of within ninety (90) calendar days of excavation. No treatment may occur at the staging area. Pursuant to the MCP and RCRA, hazardous Remediation Waste (e.g., Hazardous soils) shall be removed from the site within 90 days. All other Remediation Waste (e.g., Contaminated soils) shall be removed within 120 days unless exceptions identified at 310 CMR 40.0031(7) apply.
 - H. Contaminated and Hazardous excavated soils shall be completely covered and secured in accordance with this. Soils exhibiting evidence of potential contamination including but not limited to odors and/or staining shall be covered prior to characterization and off-site reuse or disposal.
 - I. The Contractor shall be responsible to inform the Owner if hazardous waste disposal will not be performed within 90 days of hazardous waste characterization. This notification shall take place a minimum of 30 days prior to the 90-day deadline. No hazardous waste stockpiled at the site shall remain on site more than 90 days after it is characterized. In accordance with 310 CMR 40.0031, all other Remediation Waste shall not remain on site or temporary off-site storage location more than 120 days from initial date of generation.
 - J. Transporters of solid wastes that include, but are not limited to, contaminated soil/fill (including OHM-contaminated soil), construction and demolition debris non-hazardous laboratory wastes, bottles, tires, metal parts, tree stumps, brush, and grass cuttings will utilize trucks or dumpsters specifically designed to ensure that material, dust, or liquid is not released in transit. No truck shall be allowed to exit the site until

all free liquids are drained from soil being transported off-site. Moisture content of the soil/waste shall be reduced by the Contractor, to or below the maximum acceptance limits required by the disposal facility. Material shall be covered at all times. The vehicle in which the waste is transported shall be driven directly to the intended destination without any stops or detours in between, except those necessary in response to road conditions, vehicle service needs, or emergencies. Discharge or release of material during transport shall be immediately reported to the Owner. Transporters shall clean up any discharge that occurs in transit, at the Contractor's expense.

- K. Manifesting of solid waste shall be required and shall include at a minimum: vehicle identification; date of loading and disposal; tonnage, as measured at the disposal site; and signature of the Owner and/or its representative, transporter, and disposal facility's representative. Transportation of the wastes shall be accompanied by the appropriate manifests such as a MassDEP Bill of Lading, as required in the Code of Massachusetts Regulations (CMR) 310 CMR 40.0030, a Material Shipping Record or by a Uniform Hazardous Waste Manifest. The original shall be returned to the Owner, and/or their representative, within ten (10) working days of disposal.

3.04 STAGING AREAS AND STOCKPILING

- A. Prior to disposal, the Contractor shall maintain segregated excess excavated soil and waste stockpiles in conformance with all applicable federal, state and local waste disposal regulations. No staging of asbestos materials or asbestos containing soils shall be allowed except at the direction of the Owner.
- B. The Contractor's staging area shall be large enough to store equipment, materials and all stockpiled soils. The Contractor shall protect the staging area from contamination due to excavating, handling, storing and disposing of hazardous materials.
- C. Stockpiles of excavated natural soils shall always be kept separate from excavated fill materials. Stockpiles of natural soils shall be covered with 6 mil polyethylene.
- D. Excavated fill materials stockpiled shall be placed on 6 mil polyethylene and covered with 6 mil polyethylene.
- E. The Contractor is responsible for all construction, protection, movement, and maintenance of stockpiles. Once the stockpiles have been removed the Contractor is responsible for proper disposal of all covers and liners.
- F. Stockpiled soils determined to be Contaminated or Hazardous, as described herein, shall be securely covered at the close of each day and continuously when not being added to or otherwise being handled by the Contractor. Stockpiles shall also be covered at times as directed by the Engineer.
- G. Stockpiles of soils that are known or suspected to be hazardous within the soil staging areas shall be placed on a 6-mil polyethylene, filter fabric and bermed to minimize the potential for contamination release. Each soil category shall be staged

in separate areas with barriers to keep different soil types from mixing. Waste characterized as RCRA hazardous waste or other Hazardous soils shall not be stored on site for a period greater than ninety (90) days. All other waste, including Unregulated or Contaminated soils, must be disposed of off-site within 120 days of excavation. At the end of each working day, contaminated soils will be covered with 6-mil polyethylene to minimize the potential for release of contaminants.

- H. Covers on stockpiles of soils that are known or suspected to be hazardous shall be secured with tires, ropes, anchors or equivalent material. The cover system shall be capable of resisting actual wind gusts at the site, with a minimum wind capacity of 40 miles per hour. The stockpile covers shall be installed and secured at the end of each working day and at all times when earthwork is not taking place on site. Stockpile covers shall be immediately re-covered should wind forces expose any of the excavated materials. Failure to adequately protect the stockpiles may result in non-payment.
- I. Stockpiles are to be segregated based on visual, olfactory, and field screening results. Similar material may be stockpiled together. Each stockpile must be clearly separated from adjacent stockpiles.
- J. Stockpiles will be clearly designated by a sign post or marker which can be cross-referenced with samples collected from the pile for characterization purposes. The signs/markers are not to be moved, except by authorized personnel and not until the soil is ready to be either reused on site or loaded for off-site disposal.
- K. Unknown, potentially hazardous soils/debris and drummed materials encountered during the project shall be located in a separate bermed location. The Contractor's Soil and Waste Management Plan shall provide construction details of the dimensions and protective measures proposed for the staging area(s). The construction details and protective measures are subject to the approval of the Owner and/or its representatives. The Contractor shall select the area to facilitate handling of the material and to minimize interference with other ongoing construction activities. The Owner or Engineer must agree with the location prior to construction. In the event that excavation is conducted near storm water drainage basins or inlet manholes, the Contractor must protect the drainage structures with filter fabric or provide similar protection to prevent sediment loading and migration of contaminated soils and sediments.
- L. If the soil storage area consists of an unimproved or otherwise pervious surface, and soil to be stockpiled is known or suspected to be contaminated, the Contractor shall install a lining of 6-mil (or greater) polyethylene, to protect the soil from the potential of intermixing with existing subsurface soils.
- M. Stockpiles shall be no greater than 250 cubic yards in volume. If space constraints, etc. make it infeasible to maintain separate stockpiles of soils to 250 cubic yards, the Waste Management Plan shall include a map with the locations of the composite samples for each stockpile shall be provided to the Resident Engineer prior to the submittal of the samples to the off-site analytical laboratory. This will allow any

portion of the stockpile, which came back as contaminated soil to be properly segregated and managed separately.

- N. Stockpiles shall be established and maintained as per EPA requirements under the Construction General Permit Section 2.1.2.4. Requirements include the following.
 - 1. Locate the piles outside of any natural buffers and physically separated from other storm water controls;
 - 2. Protect from contact with storm water (including run-on) using a temporary perimeter sediment barrier;
 - 3. For all soils, provide cover or appropriate temporary stabilization to minimize sediment discharge and to contain and securely protect from wind; nevertheless, the Contractor shall provide cover for any stockpiles containing contaminated soils as specified herein;
 - 4. Do not hose down or sweep soil or sediment accumulated on pavement or other impervious surfaces into any storm water conveyance (unless connected to a sediment basin, sediment trap, or similarly effective control), storm drain inlet, or surface water; and
 - 5. Unless infeasible, contain and securely protect from wind.

3.05 HAZARDOUS WASTES

- A. Transporters of hazardous wastes shall be in conformance with Code of Federal Regulations (CFR) 40 CFR, Part 171, all other federal laws and regulations and 310 CMR 30.400, and all other state laws through whose boundaries the waste material is being transported. The transporter shall provide copies of its EPA identification number, Massachusetts transporter's license, and proof of driver training in transporting hazardous waste.
- B. The disposal site shall be in conformance with 40 CFR, Part 264 and relevant laws of the state in which the facility is located. The Contractor shall provide copies of the disposal facility's EPA and state treatment and disposal permit.
- C. Manifesting of hazardous wastes shall be in conformance with 40 CFR, Part 264, Subpart E, 310 CMR 30.310 and 310 CMR 30.405.
- D. Actual quantities which are subject to unit rates shall be tabulated by the Contractor and verified by the Engineer on a daily basis. The Contractor shall not be reimbursed for unit rate work performed without the prior approval of quantities by the Engineer.

3.06 EQUIPMENT AND PERSONNEL DECONTAMINATION

- A. Equipment and personnel decontamination facilities shall be provided by the Contractor when hazardous materials are expected to be encountered and handled onsite. Equipment and personnel decontamination area(s), conforming with the Contractor's HASP and these Specifications, will be constructed in such a manner to protect existing site surfaces, materials, and structures from contamination. The equipment decontamination area(s) will be sized adequately to provide for the

decontamination of the largest piece of equipment to be decontaminated. Filter fabric will be placed over an impermeable liner to protect the liner from rips, punctures, or tears from traffic and heavy equipment.

- B. The Contractor shall establish a site-specific decontamination protocol and decontamination areas for personnel and equipment utilized at the subject site. Personnel and equipment decontamination shall be conducted in compliance with the HASP.
- C. The decontamination protocol shall include (i) the means, methods, and materials for the proposed decontamination procedures; (ii) the procedures employed to contain and store the wash or rinse liquids/sludges; (iii) procedures used to sample, analyze, and characterize the contaminated wash or rinse liquids/sludges; (iv) procedures to contain or clean contaminated equipment and PPE; and (v) the procedures for handling and disposing of solid wastes generated from site decontamination activities. All sample analysis shall be completed by a certified laboratory. The Contractor shall be responsible for the cost of this analytical work. The Contractor shall submit a copy of the analytical results and laboratory certifications to the Owner for review prior to proceeding with disposal. The Contractor shall be responsible to properly manifest and dispose of all residual wastes generated from on-site activities in conformance with federal, state, and local environmental and transportation regulations. The Contractor shall be responsible for the manifests and procedures to be used to package and dispose of contaminated solid wastes, wash, or rinse liquids at an EPA or state-approved treatment or disposal facility. The Contractor shall be responsible for any releases from site or decontamination activities due to its work, and will remediate any release for which the Contractor is responsible to pre-existing conditions at the Contractor's expense.
- D. Provisions for collecting decontamination water will be incorporated into the maintenance of the decontamination pad and will include placing an impermeable liner over a sloped surface such that water is directed, if necessary, into an area for subsequent pumping to 55-gallon drums or other appropriate tankage. Following completion of the work, the wash water shall be characterized by the Contractor and disposed off-site, in accordance with federal, state, and local regulations.

3.07 ENVIRONMENTAL FIELD MONITORING / DUST CONTROL

- A. The air monitoring program is to be designed to protect public health and the environment from the potential generation of dust and contaminant release during work. All personnel shall be made aware of the potential hazards and be informed of air monitoring information by the Contractor.
- B. Dust control measures shall be implemented by the Contractor during all soil handling operations, loading and transport of waste material from the site in accordance with the Contractor's Dust Control Plan.
- C. Air monitoring shall occur when excavating or handling soils that are known or suspected to be hazardous or contain OHM. The Contractor shall keep accurate

documentation of all air monitoring, which will be made available to the Engineer or Owner upon request.

1. At a minimum, the air monitoring shall include daily monitoring and documentation of one upwind, and two downwind conditions during periods of activity on the site and when there is a potential for dust being generated on the site. The air monitoring information including air monitoring in the vicinity of all site activities shall also be utilized for establishing levels of personal protection measures in the Contractor's Site Specific Health and Safety Plan. The Contractor shall submit his/her air quality monitoring program for review and approval prior to commencement of site activities.
 2. Air monitoring shall include headspace analyses in a jar or plastic bag performed using a portable photoionization detector or other appropriate instrument for the anticipated conditions. The Contractor shall be responsible for properly calibrating the instrument each day and recording the calibration in a daily log which shall include the following information:
 - a. Name of device or instrument calibrated.
 - b. Date of calibration.
 - c. Results of calibration.
 - d. Name of person performing the calibration.
 - e. Identification of the calibration gas.
 3. The Contractor is responsible for providing fully charged instrument(s) at the start of each work day.
 4. When applicable, field screening samples shall be taken from numerous locations within the excavation. Samples shall be taken from any area that appears to be visibly contaminated or where an odor is noted.
- D. If there are indications of contamination, the frequency of air monitoring will be determined by an Industrial Hygienist or competent environmental health professional. The Contractor's Site Health and Safety Officer and Superintendent will be responsible for assuring that monitoring is conducted in an appropriate manner, and that work practices, engineering controls and/or Personal Protective Equipment are proper for the conditions.
- E. Dust shall be controlled during excavation of soil/fill waste material to limit potential spread of contaminants and potential exposure of contaminants to workers and the public.
- F. During construction, real-time dust monitoring shall be conducted under windy and/or excessively dry working conditions or when directed by the Engineer. The monitoring shall consist of total dust testing using MIE, INC. MINIRAM PDM-3 DUST MONITORS, or like instruments. The total dust criteria at the site shall conform to the requirements of the HASP. Should fugitive dust quantities exceed 20 percent of the ambient level or action levels indicated within the HASP, the Contractor shall perform additional measures to reduce the total dust concentrations.
- G. Nuisance dust levels shall be reduced by pre-wetting the surface soils and by establishing and maintaining clean access roads. The Contractor's Dust, Vapor, and Odor Control Plan shall describe the procedures and materials to minimize dust. At

a minimum, the Contractor shall provide clean water, free from salt, oil, and other deleterious materials.

- H. Areas of exposed earth to be excavated shall be lightly sprayed with water before excavation if there is potential for nuisance dust generation. Additional water spray may be utilized only when any indication of excessive dust is observed. To the extent feasible, the Contractor shall minimize the use of water within the limits of excavation.
- I. Unimproved access roads shall be sprayed with water on a regular basis to minimize the generation of dust.
- J. All containers temporarily storing waste material shall be covered at all times except as necessary to place waste material into the container. The Contractor shall monitor the covers daily to ensure the covers are in place and effectively eliminating the generation of dust and make appropriate notes in the site log.

3.08 VAPOR AND ODOR CONTROL

- A. The Contractor shall provide the materials and labor to control objectionable vapors and odor in accordance with the Contractor's SWMP. The Contractor shall limit the exposure area and shall cover the exposure area with synthetic reusable covers, lime, foam suppressants, or other methods to reduce off-site odors to acceptable levels. The Contractor shall not use soil suitable for on-site reuse as cover to control vapor and odors.

3.09 BULKING

- A. Following characterization and compatibility testing of waste material, the Contractor shall place compatible materials into common containers to reduce transport and disposal costs, when practicable and with the approval of the Engineer. In addition, materials that are improperly contained shall be transferred into the appropriate containers. Drums and containers used during this project shall meet the appropriate DOT, OSHA, and U.S. EPA regulations for the materials contained. The Contractor shall describe the bulking procedures in the Soil and Waste Management Plan.

3.10 CONTAMINATED LIQUIDS

- A. The Contractor shall collect and properly dispose of contaminated liquids and other liquids generated or encountered on site during construction. Contaminated liquid sources include decontamination water, and drummed liquids encountered during excavation. The Contractor shall be responsible for treating and disposing of contaminated groundwater as required by applicable regulations and SECTION 02140 DEWATERING.

3.11 STORMWATER CONTROL

- A. The Contractor shall protect all work from erosion while onsite. The Contractor shall divert all stormwater from work areas that may contain oil or hazardous materials (OHM). Stormwater that may contact OHM, polychlorinated biphenyls (PCBs), lead, asbestos or other types of impacted soil shall be collected within the immediate area of the contact, treated (as determined by sampling and testing) and disposed of in accordance with all local, state and federal regulations. Stormwater that is collected, stored onsite and sampled shall be tested and characterized for determining proper transportation, disposal and/or discharge in accordance with SECTION 02140 DEWATERING.

3.12 BACKFILLING AND COMPACTION

- A. Excavated areas shall be backfilled with appropriate backfill material (including excavated material suitable for reuse and, when necessary, imported off-site material) as specified in SECTION 02200 - EARTH EXCAVATION, BACKFILL, FILL AND GRADING.

3.13 CLEANUP

- A. During the course of the work, the Contractor shall keep the Site and his operations clean and neat at all times. He shall dispose of all residue resulting from the site clearing operations; and at the conclusion for the day's Work, he shall remove and haul away any surplus materials, lumber, equipment, temporary structures, and any other refuse remaining from the site clearing operations and shall leave the entire site in a neat and orderly condition.

Sample Waste Stream Disposal Summary Table

Material Type	Pre-Approval by Receiving Facility	Testing/ Analysis	Transportation Documentation	Proposed Receiving Facility/Facilities
Asbestos Containing Material (ACM)	Required	Not required	WSR	
Asbestos Cement Pipe (ACP)	Required	Not required	WSR	
Unregulated Soils	Required	Required	MSR	
Impacted/Regulated Soils	Required	Required	BOL	
Hazardous materials	Required	Required	HWSM	
Catch basin cleanings	Required	Required	WSR	
Street Sweepings	Required	Not required	WSR	
Contaminated Dewatering liquids	Required	Required	BOL	
Uncontaminated dewatering liquids	Required	Not required	Not required	
Sanitary Sewerage	Not required	Not required	Not required	
Asphalt, Brick and Concrete Material (ABC)	Not required	Not required	MSR, MassDEP notification form if crushed	
Construction Debris	Not required	Not required	Not required	
Vegetation	Not required	Not required	Not required	
Municipal Solid Waste	Not required	Not required	Not required	
Recyclable Materials	Not required	Not required	Not required	

END OF SECTION 02080

SECTION 02082

ASBESTOS ABATEMENT

PART 1 - GENERAL

1.01 SUMMARY

- A. Remove, encapsulate, or otherwise abate asbestos-containing materials (ACM) as described herein.
- B. Dispose ACM in accordance with governing laws and regulations; pay costs of permits and disposal.

1.02 CODES, REGULATIONS, AND STANDARDS - ASBESTOS ABATEMENT

- A. Federal Requirements that govern asbestos abatement work or hauling and disposal of asbestos waste materials include but are not limited to the following specifications:
 - 1. OSHA: U.S. Department of Labor, Occupational Safety and Health Administration, (OSHA), including but not limited to the following regulations:
 - a. Respiratory Protection: Title 29, Part 1910, Section 134 of the Code of Federal Regulations
 - b. Construction Industry: Title 29, Part 1926, of the Code of Federal Regulations
 - c. Hazard Communication: Title 29, Part 1910, Section 1200 of the Code of Federal Regulations
 - 2. DOT: U.S. Department of Transportation, including but not limited to the following regulation:
 - a. Hazardous Substances: Title 29, Part 171 and 172 of the Code of Federal Regulations
 - 3. EPA: U.S. Environmental Protection Agency (EPA), including but not limited to the following regulations:
 - a. Asbestos Abatement Projects; Worker Protection Rule: Title 40 Part 763, Sub-part G of the Code of Federal Regulations
 - b. Asbestos Hazard Emergency Response Act (AHERA) Regulation: Asbestos Containing Materials in Schools Final Rule & Notice, Title 40, Part 763, Sub-part E of the Code of Federal Regulations
 - c. Training Requirements of (AHERA) Regulation: Asbestos Containing Materials in Schools Final Rule & Notice, Title 40, Part 763, Sub-part E, Appendix C of the Code of Federal Regulations

- d. National Emission Standard for Hazardous Air Pollutants (NESHAPS): National Emission Standard for Asbestos, Title 40, Part 61, Sub-part A, and Sub-part M (Revised Sub-part B) of the Code of Federal Regulations
- B. State Requirements that govern asbestos abatement work or hauling and disposal of asbestos waste materials include but are not limited to the following:
1. Department of Environmental Protection (310 CMR 7.00 and 310 CMR 7.00 7.15, 310 CMR 40.0000, 310 CMR 4.00, 310 CMR 19.061 and 310 CMR 16.00)
 2. Department of Labor and Work Force Development (453 CMR 6.00—The Removal, Containment or Encapsulations of Asbestos)
- C. Local requirements that govern asbestos abatement work or hauling and disposal of asbestos waste materials include but are not limited to the following:
1. Local Department of Health (project notification)
- D. Standards:
1. General Applicability of Standards: Except to the extent that more explicit or more stringent requirements are written directly into the Contract Documents, all applicable standards have the same force and effect (and are made a part of the Contract Documents by reference) as if copied directly into the Contract Documents, or as if published copies are bound herewith.
 2. Contractor Responsibility: The Contractor shall assume full responsibility and liability for the compliance with all standards pertaining to work practices, hauling, disposal, and protection of workers, visitors to the site, and persons occupying areas adjacent to the site.
 3. Standards that apply to asbestos abatement work or hauling and disposal of asbestos waste materials include but are not limited to the following ANSI and ASTM standards.
 4. American National Standards Institute (ANSI), 1430 Broadway, New York, New York 10018, (212) 354-3300
 - a. Fundamentals Governing the Design and Operation of Local Exhaust Systems, Publication Z9.2-79
 - b. Practices for Respiratory Protection Publication Z88.2-80
 5. American Society for Testing and Materials (ASTM), 1916 Race Street, Philadelphia, PA 19103, (215) 299-5400
 - a. Safety and Health Requirements Relating to Occupational Exposure to Asbestos, ASTM E 849-82

- E. EPA Guidance Documents: listed below are documents discussing asbestos abatement work or hauling and disposal of asbestos waste materials, and are for the Contractor's information only. These documents do not describe the work and are not a part of the work of this contract. EPA maintains an information number (800) 334-8571, and publications can be ordered from (800) 424-9065 (554-1404 in Washington, DC):
1. *Guidance for Controlling Asbestos-Containing Materials in Buildings* (Purple Book) EPA 560/5-85-024.
 2. *Asbestos in Buildings: Guidance for Service and Maintenance Personnel*. EPA 560/5-85-018.
 3. *Asbestos Waste Management Guidance*. EPA 530-SW-85-007.
 4. *A Guide to Respiratory Protection for the Asbestos Abatement Industry*. EPA-560-OPTS-86-001.
- F. Posting and Filing of Regulations: Post all notices required by applicable federal, state, and local regulations. Maintain two (2) copies of applicable federal, state, and local regulations and standard. Maintain one copy of each at job site. Keep on file in Contractor's office one copy of each.

1.03 DEFINITIONS AND STANDARDS - ASBESTOS ABATEMENT

- A. Air Lock: A mechanism or system of enclosures within the decontamination facility that does not allow air movement between clean and contaminated areas. Consists of a three-foot wide space between each of the sections of the decontamination chamber segregated by full polyethylene barriers.
- B. Amended Water: Water to which a surfactant has been added to decrease the surface tension to 35 or less dynes.
- C. Asbestos: The asbestiform varieties of serpentine (Chrysotile), riebeckite (crocidolite), cummingtonite-grunerite, anthophyllite, and actinolite-tremolite. For purposes of determining respiratory and worker protection both the asbestiform and non-asbestiform varieties of the above minerals and any of these materials that have been chemically treated and/or altered shall be considered as asbestos.
- D. Asbestos-Containing Material (ACM): Any material containing more than 1% by weight of asbestos of any type or mixture of types.
- E. Asbestos-Containing Waste Material: Any material that is or is suspected of being or any material contaminated with an asbestos-containing material that is to be removed from a work area for disposal.
- F. Asbestos debris: Pieces of ACM or ACBM that can be identified by color, texture, or composition. Also inclusive of dust, if the dust is determined by an accredited inspector to be ACM.

- G. Authorized Visitor: The Owner, the Engineer, testing lab personnel, the Engineer/Engineer, emergency personnel, or a representative of any federal, state, and local regulatory or other agency having authority over the project.
- H. Barrier: Any surface that seals off the work area to inhibit the movement of fibers.
- I. Breathing Zone: A hemisphere forward of the shoulders with a radius of approximately 6 to 9 inches.
- J. Ceiling Concentration: The concentration of an airborne substance that shall not be exceeded.
- K. Decontamination Facility: A series of interconnected chambers, typically segregated by polyethylene barriers, that is used as the only means of worker ingress/egress to the work area. Interlocking barriers prevents contamination of areas outside the work area.
- L. Disposal Bag: A properly labeled 6-mil thick leak-tight plastic bag used for transporting asbestos waste from work and to disposal site.
- M. Encapsulant: A material that surrounds or embeds asbestos fibers in an adhesive matrix in order to prevent release of fibers.
 1. *Bridging encapsulant*: an encapsulant that forms a discrete layer on the surface of an in situ asbestos matrix.
 2. *Penetrating encapsulant*: an encapsulant that is absorbed by the in situ asbestos matrix without leaving a discrete surface layer.
- N. Encapsulation: Treatment of asbestos-containing materials with an encapsulant.
- O. Equipment Room: A contained room or chamber positioned immediately contiguous to the contaminated work area environment that is used for removal of protective clothing and decontamination of equipment.
- P. Friable Asbestos Material: Material that contains more than 1.0% asbestos by weight and that can be crumbled, pulverized, or reduced to powder by hand pressure when dry.
- Q. HEPA Filter: A High Efficiency Particulate Air (HEPA) filter capable of trapping and retaining 99.97% of asbestos fibers greater than 0.3 microns in diameter.
- R. HEPA Filter Vacuum Collection Equipment (or vacuum cleaner): High efficiency particulate air filtered vacuum collection equipment with a filter system capable of collecting and retaining asbestos fibers. Filters should be of 99.97% efficiency for retaining fibers of 0.3 microns or larger.
- S. Negative Pressure Respirator: A respirator in which the air pressure inside the respiratory-inlet covering is positive during exhalation in relation to the air pressure of

the outside atmosphere and negative during inhalation in relation to the air pressure of the outside atmosphere.

- T. Negative Pressure Ventilation System: A pressure differential and ventilation system.
 - U. Personal Monitoring: Sampling of the asbestos fiber concentrations within the breathing zone of an employee.
 - V. Pressure Differential and Ventilation System: A local exhaust system, utilizing HEPA filtration, capable of maintaining a pressure differential within the Work Area at a lower pressure than any adjacent area, and which cleans recirculated air or generates a constant air flow from adjacent areas into the Work Area.
 - W. Protection Factor: The ratio of the ambient concentration of an airborne substance to the concentration of the substance inside the respirator at the breathing zone of the wearer. The protection factor is a measure of the degree of protection provided by a respirator to the wearer.
 - X. Respirator: A device designed to protect the wearer from the inhalation of harmful atmospheres.
 - Y. Surfactant: A chemical wetting agent added to water to improve penetration, thus reducing the quantity of water required for a given operation or area.
 - Z. Time Weighted Average (TWA): The average concentration of a contaminant in air during a specific time period.
 - AA. Visible Debris: Any visually detectable particulate residue such as dust, dirt, or other extraneous material that may or may not contain asbestos.
 - BB. Visible Emissions: Any emissions containing particulate asbestos material that are visually detectable without the aid of instruments. This does not include condensed uncombined water vapor.
 - CC. Wet Cleaning: The process of eliminating asbestos contamination from building surfaces and objects by using cloths, mops, or other cleaning utensils which have been dampened with amended water or diluted removal encapsulant and afterwards thoroughly decontaminated or disposed of as asbestos-contaminated waste.
 - DD. Work Area: The area where asbestos-related work or removal operations are performed which is defined and/or isolated to prevent the spread of asbestos dust, fibers, or debris, and entry by unauthorized personnel. Work area is a Regulated Area as defined by 29 CFR 1926.
- 1.04 STOP WORK
- A. If the Engineer or Owner presents a signed written stop work order, stop abatement work immediately. Do not recommence work until authorized in writing by the Owner.

1.05 SUBMITTALS

- A. Submit the following items to the Engineer for review and approval. Do not begin work until the Engineer has approved these submittals.
1. Plan of Action: Submit a detailed plan of the procedures proposed for use in complying with the requirements of this Section. Include in the plan the location and layout of decontamination areas, the sequencing of asbestos work, the interface of trades involved in the performance of work, methods to be used to assure the safety of building occupants and visitors to the site, disposal plan including location of approved disposal site, and a detailed description of the methods to be employed to control pollution. Expand upon the use of portable HEPA ventilation system, closing out of the building's HVAC system, method of removal to prohibit visible emissions in work area, and packaging of removed asbestos debris. The Engineer prior to commencement of work must approve the plan.
 2. Contingency plans for emergency actions.
 3. Resume of Supervisor for asbestos abatement.
 4. Accreditation and Certification: submit evidence in form of training course certificate of accreditation of Supervisor as an asbestos abatement supervisor and Workers as asbestos abatement workers. Also, submit applicable Massachusetts DLWD personnel certifications. All personnel also must carry certifications on-site. Personnel without such certificates may not perform any functions related to asbestos abatement.
 5. Permit: Submit evidence that asbestos waste transporter maintains a current "Industrial waste hauler permit" specifically for asbestos-containing materials, as required for transporting of asbestos-containing materials waste to a disposal site.
 6. Waste disposal: Submit name, address, telephone number and asbestos waste permit information for landfill where asbestos waste will be disposed.
 7. Submit a draft copy of the Asbestos Notification Form to the Engineer for review and approval. The ANF shall be submitted to MassDEP 10-working days prior to the anticipated start of asbestos abatement.
- B. Submit the following for the Engineer's Information:
1. Telephone numbers and location of emergency services.
 2. Copy of Notifications sent to other entities at the work site.
 3. Copy of Notifications sent to emergency service agencies.

4. Permits, Licenses, and Certificates: For the Engineer's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, and similar documents, correspondence and records established in conjunction with compliance with standards and regulations bearing upon performance of the Work including:
 - a. State and Local Regulations: Submit copies of codes and regulations applicable to the work.
 - b. Notices: Submit notices required by federal, state and local regulations together with proof of timely transmittal to agency requiring the notice.
 - c. Permits: Submit copies of current valid permits required by state and local regulations.
 - d. Licenses: Submit copies of all State and local licenses and permits necessary to carry out the work of this contract, including abatement contractor's Massachusetts Department of Labor and Industries asbestos abatement contractor license.
 5. Respiratory Protection Program: Submit program manual, protection schedule, and historic airborne fiber data applicable to this project.
- C. Asbestos Abatement Schedule: Provide proposed detailed schedule including work dates, work shift time, number of employees, dates of start and completion including dates of preparation work, removals and final inspection dates.
1. Indicate completion and Clearance of each Work Area in advance of the date established for Substantial Completion. Allow time for testing and other Engineer's procedures necessary for certification of Clearance and Substantial Completion.
 2. Work Stages: Indicate important stages of construction for each major portion of the work, including testing and installation. Include indication of start and finish times for the following:
 - a. Preparation of the Work Area.
 - b. Asbestos removal.
 - c. Clearance testing.
 3. Schedule Updating: Revise the schedule after each meeting or activity where revisions have been recognized or made. Issue the updated schedule concurrently with report of each meeting.
- D. Prior to submitting the ANF to MassDEP, contractor shall evaluate the quantity of asbestos containing materials in each area of work and submit the quantity for written approval to the Engineer. It shall include the location, date, quantity of asbestos material, and name of the authorized person conducting the quantification. The

Contractor's third-party Air Monitoring Technician shall verify all asbestos material quantification before work is begun.

- E. At completion of asbestos abatement, submit copies of the waste shipment record(s) for all asbestos waste transported from the site, copies of worker logs, copies of workers' certifications as asbestos abatement workers, and any other pertinent information relative to the project.

1.06 NOTIFICATIONS

- A. Notify other entities at the job site of the nature of the asbestos abatement activities, location of asbestos-containing materials, requirements relative to asbestos set forth in these specifications and applicable regulations.
- B. Notify emergency service agencies including fire, ambulance, police or other agency that may service the abatement work site in case of an emergency. Notification is to include methods of entering work area, emergency entry and exit locations, modifications to fire notification or fire fighting equipment, and other information needed by agencies providing emergency services.
- C. Notifications of Emergency: Any individual at the job site may notify emergency service agencies if necessary without effect on this Contract or the Contract Sum.
- D. Notify federal, state, and local agencies having jurisdiction over the work including:
 - 1. Environmental Protection Agency: In Massachusetts, the notification sent to the Massachusetts Department of Environmental Protection for asbestos removal will be sufficient to meet the EPA notification requirement under the National Emission Standards for Hazardous Air Pollutants (NESHAP) Asbestos Regulations (40 CFR 61 Subpart M).
 - 2. State and Local Agencies: Send written notification and pay fees, as applicable, as required by state and local regulations prior to beginning any work on asbestos-containing materials. In Massachusetts, notify the Department of Environmental Protection and the Department of Labor and Workforce Development within 10 working days of beginning any asbestos abatement.
 - 3. Notify the local Department of Health within 10 days of beginning any asbestos abatement.

1.07 QUALITY ASSURANCE

- A. Licenses: The Contractor conducting asbestos abatement activities must maintain current licenses as required by applicable state or local jurisdictions for the removal, transporting, disposal or other regulated activity relative to the work of this contract, including a Massachusetts Department of Labor and Industries license as an Asbestos Abatement Contractor.

- B. Certifications: All personnel conducting asbestos abatement activities shall be certified by the Department of Labor and Work Force Development as Asbestos Abatement Workers and Asbestos Abatement Supervisors, as applicable, to their role on the project.
- C. Continuously monitor and record the pressure differential between the Work Area and the building outside of the Work Area with a monitoring device.

1.08 PROJECT/SITE CONDITIONS

- A. The disturbance or dislocation of asbestos-containing materials (ACM) may cause asbestos fibers to be released into the buildings atmosphere, thereby creating a potential health hazard to workers and building occupants. Thus, to prevent ACM from becoming a hazard, the Contractor shall abate the ACM in the proper sequence of the project before the materials are disturbed by any renovation or demolition. Apprise all workers, supervisory personnel, subcontractors and consultants who will be at the job site of the seriousness of the hazard and of proper work procedures that must be followed.
- B. Where in the performance of the work, workers, supervisory personnel, subcontractors, or Consultants may encounter, disturb, or otherwise function in the immediate vicinity of any identified asbestos-containing materials or any material suspected of containing asbestos, take appropriate precautionary measures as necessary to protect all building occupants from the potential hazard of exposure to airborne asbestos. Such measures shall include the procedures and methods described herein, and compliance with regulations of applicable federal, state and local agencies. Materials that may be encountered that are not included in the following table that are suspected of containing asbestos should be assumed to contain asbestos unless appropriate testing and analysis demonstrates otherwise.
- C. Asbestos has been identified in the following materials. Please refer to Appendices A more information on these materials.

Results of Testing for Asbestos Worcester Road Wastewater Pumping Station Framingham, Massachusetts		
Type of Material	Location	Quantity
Black vapor barrier	Wall/Foundation	120 sf
Black roof tar flashing and felts	Roof system	825 sf
Gray exterior window and vent caulking compound	Windows	6 Windows and 2 Vents

1.09 CONTRACTOR'S THIRD PARTY TESTING

- A. The Contractor will employ a Testing and Inspection Agency to perform the air monitoring specified in this Article in order to verify that the building beyond the work area and the outside environment remains uncontaminated.
 - 1. This Article also sets forth airborne fiber levels both inside and outside the work area as action levels, and describes the action required by the Contractor if an action level is met or exceeded.
 - 2. Analytical Methods: The following methods will be used by the Owner's Testing and Inspection Agency in analyzing filters used to collect air samples. Sampling rates may be varied from printed standards to allow for high volume sampling.
 - a. Phase Contrast Microscopy (PCM) will be performed using the NIOSH 7400 method. This analysis will be carried out at the job site.
- B. Air monitoring required by OSHA is work of the Contractor and is not covered in this section.
- C. Work Area Isolation: The purpose of the Owner's Testing and Inspection Agency air monitoring during abatement work is to detect faults in the work area isolation such as:
 - 1. Contamination of the building outside of the work area with airborne asbestos fibers,
 - 2. Failure of filtration or rupture in the differential pressure system,
 - 3. Contamination of air outside the building envelope.
 - 4. Should any of the above occur, immediately cease asbestos abatement activities until the fault is corrected. Do not recommence work until authorized by the Architect.
- D. Work Area Airborne Fiber Count: The Owner's Testing and Inspection Agency will monitor airborne fiber counts in the Work Area. The purpose of this air monitoring will be to detect airborne asbestos concentrations that may challenge the ability of the Work Area isolation procedures to protect the balance of the building or outside of the building from contamination by airborne fibers.
- E. Work area clearance: To determine if the elevated airborne fiber counts encountered during abatement operations have been reduced to an acceptable level, the Owner's Testing and Inspection Agency will sample and analyze air samples in accordance with the requirements of 40 CFR Part 763.
 - 1. Aggressive Sampling: Air samples will be taken using aggressive sampling techniques as follows:
 - a) Before sampling pumps are started the exhaust from forced-air equipment (leaf blower with an approximately 1 horsepower electric motor) will be swept against walls, ceilings, floors, ledges and other surfaces in the room. This procedure will be continued for 5 minutes per 10,000 cubic feet of room volume.

- b) One 20-inch diameter fan per 10,000 cubic feet of room volume will be mounted in a central location at approximately 2 meters above floor, directed toward ceiling and operated at low speed for the entire period of sample collection.
 - c) Air samples will be collected in areas subject to normal air circulation away from room corners, obstructed locations, and sites near windows, doors of vents.
 - d) After air-sampling pumps have been shut off, fans will be shut off.
2. Schedule of Air Samples: The number and volume of air samples taken and analytical methods used by the Architect will be in accordance with the following schedule. Sample volumes given may vary depending upon the analytical instruments used.
- a. Testing for airborne fiber concentration will be performed using Phase Contrast Microscopy. In each homogeneous Work Area, after completion of cleaning work, a minimum of five samples will be taken and analyzed. Samples will be collected 0.8 mixed cellulose ester filter media in 25-millimeter cassettes with a conductive extension cowl.

Location Sampled	Number of Samples	Analysis Method	Detection Limit Fibers/cc	Minimum Volume (LITERS)	Rate (LPM)
Each Work Area Or	1/1000 sf	PCM	0.01	1,200	1-10
Each room	1	PCM	0.01	1,200	1-10
Work Area Blank	1	PCM	0.01	0	Open for 30 Seconds
Lab Blank	1	PCM	0.01	0	Do not open

- 1) Analysis: Fibers on each filter will be measured using the NIOSH Method 7400 entitled "Fibers" published in the NIOSH Manual of Analytical Methods, 3rd Edition, Second Supplement, August 1987.
 - 2) Fibers referred to in this section include fibers regardless of composition as counted by the phase contrast microscopy method used.
 - 3) Release Criteria: Decontamination of the work site is complete when every Work Area sample is at or below 0.01 fibers per cubic centimeter of air (f/cc). If any sample is above this level, then the decontamination is incomplete and recleaning per Article 3.3 of this Section is required.
- b. If clearance criteria cannot be met by PCM analysis due to site conditions, testing for airborne fiber concentration will be performed using Transmission Electron Microscopy. Samples will be collected and analyzed according to the AHERA method specified in 40 CFR Part 763.

- 1) Release Criteria: Decontamination of the work site is complete when every Work Area sample is at or below the criteria specified by AHERA. If these release criteria are not met, then the decontamination is incomplete and recleaning per Article 3.3 of this Section is required.
3. Laboratory Testing:
- a. PHASE CONTRAST MICROSCOPY: Typically, the Owner's Testing and Inspection Agency will analyze all PCM air samples on-site and results made available within 3 to 6 hours. However, if required, the services of a testing laboratory will be employed by the Owner to perform laboratory analysis of the air samples. Results will be available within 24 hours of completion of the sampling period. A complete record, certified by the testing laboratory, of air monitoring tests and results will be furnished to the Architect, the Owner and the Contractor.
 - b. TRANSMISSION ELECTRON MICROSCOPY: Samples will be sent by overnight courier for analysis by Transmission Electron Microscopy within 24 hours of receipt by laboratory. Samples will not be carried on weekends, so that samples shipped on Friday will arrive on the following Monday. Verbal results will normally be available during the 2nd working day after receipt of samples by the laboratory. The laboratory is capable of analyzing a maximum of 13 such samples from this project at any one time. Transmission Electron Microscopy results will be available to the Contractor.

F. Stop Action Levels:

1. Inside Work Area: Maintain an average airborne count in the Work Area of less than 0.5 fibers per cubic centimeter. If the fiber counts rise above this figure for any sample taken, revise work procedures to lower fiber counts. If the Time Weighted Average (TWA) fiber count for any work shift or 8-hour period exceeds 0.5 fibers per cubic centimeter, stop work, leave Pressure Differential System in operation and notify Architect. After correcting cause of high fiber levels, do not recommence work for 24 hours unless otherwise authorized, in writing, by Architect.
 - a. If airborne fiber counts exceed 2.0 fibers per cubic centimeter for any period of time cease all work except corrective action until fiber counts fall below 0.5 fibers per cubic centimeter and notify Architect. After correcting cause of high fiber levels, do not recommence work for 24 hours unless otherwise authorized, in writing, by Architect.
2. Outside Work Area: If any air sample taken outside of the Work Area exceeds 0.01 fibers/cc, immediately and automatically stop work except corrective action. The Architect will determine the source of the high reading and so notify the Contractor.
 - a. If the high reading was the result of a failure of Work Area isolation measures initiate the following actions:
 - 1) Immediately erect new critical barriers to isolate the affected area from the balance of the building. Erect Critical Barriers at the next existing structural isolation of the involved space (e.g. wall, ceiling, floor).

- 2) Decontaminate the affected area in accordance with the requirements of Part 3.06 of this Section.
- 3) Require that respiratory protection be worn in affected area until area is cleared for reoccupancy in accordance with Work Area Clearance requirements.
- 4) Leave Critical Barriers in place until completion of work and insure that the operation of the pressure differential system in the Work Area results in a flow of air from the balance of the building into the affected area.
- 5) After Certification of Visual Inspection in the Work Area remove critical barriers separating the work area from the affected area. Final air samples will be taken within the entire area as set forth herein.

- b. If the high reading was the result of other causes initiate corrective action as determined by the Architect.

G. Complete corrective work if high airborne fiber counts were caused by Contractor's activities.

PART 2 - PRODUCTS

2.01 HEPA FILTERED FAN UNITS:

- A. General: Supply the required number of HEPA filtered fan units to the site in accordance with these specifications. Use units that meet the following requirements.
- B. Cabinet: Constructed of durable materials able to withstand damage from rough handling and transportation. The width of the cabinet should be less than 30 inches to fit through standard-size doorways. Provide units whose cabinets are:
 1. Factory-sealed to prevent asbestos-containing dust from being released during use, transport, or maintenance
 2. Arranged to provide access to and replacement of air filters from intake end
 3. Mounted on casters or wheels
- C. Fans: Rate capacity of fan according to usable air-moving capacity under actual operating conditions.
- D. HEPA Filters: Provide units whose final filter is the HEPA type with the filter media (folded into closely pleated panels) completely sealed on all edges with a structurally rigid frame.
 1. Provide units with a continuous rubber gasket located between the filter and the filter housing to form a tight seal.
 2. Provide HEPA filters that are individually tested and certified by the manufacturer to have an efficiency of not less than 99.97 percent when challenged with 0.3 μm dioctylphthalate (DOP) particles when tested in accordance with Military

Standard Number 282 and Army Instruction Manual 136-300-175A. Provide filters that bear a UL586 label to indicate ability to perform under specified conditions.

3. Provide filters that are marked with the name of the manufacturer, serial number, air flow rating, efficiency and resistance, and the direction of test airflow.
- E. Prefilters, which protect the final filter by removing the larger particles, are required to prolong the operating life of the HEPA filter. Two stages of prefiltration are required. Provide units with the following prefilters:
1. First-stage prefilter: low-efficiency type (e.g., for particles 100 μm and larger)
 2. Second-stage (or intermediate) filter: medium efficiency (e.g., effective for particles down to 5 μm)
- F. Provide units with prefilters and intermediate filters installed either on or in the intake grid of the unit and held in place with special housings or clamps.
- G. Instrumentation: Provide units equipped with:
1. Magnehelic gauge or manometer to measure the pressure drop across filters and indicate when filters have become loaded and need to be changed
 2. A table indicating the usable air-handling capacity for various static pressure readings on the Magnehelic gauge affixed near the gauge for reference, or the Magnehelic reading indicating at what point the filters should be changed, noting Cubic Feet per Minute (CFM) air delivery at that point
 3. Elapsed time meter to show the total accumulated hours of operation
- H. Safety and Warning Devices: Provide units with the following safety and warning devices:
1. Electrical (or mechanical) lockout to prevent fan from operating without a HEPA filter
 2. Automatic shutdown system to stop fan in the event of a rupture in the HEPA filter or blocked air discharge
 3. Warning lights to indicate normal operation (green), too high a pressure drop across the filters (i.e., filter overloading) (yellow), and too low of a pressure drop (i.e., rupture in HEPA filter or obstructed discharge) (red)
 4. Audible alarm if unit shuts down due to operation of safety systems
- I. Electrical components: Provide units with electrical components approved by the National Electrical Manufacturers Association (NEMA) and Underwriter's

Laboratories (UL). Each unit is to be equipped with overload protection sized for the equipment. The motor, fan, fan housing, and cabinet are to be grounded.

2.02 SHEET PLASTIC

- A. Polyethylene Sheet: Provide flame-resistant polyethylene film that conforms to requirements set forth by the National Fire Protection Association Standard 701, Small Scale Fire Test for Flame-Resistant Textiles and Films. Provide largest size possible to minimize seams, 6.0 mil thick, frosted or black as indicated.
- B. Reinforced Polyethylene Sheet: Where plastic sheet constitutes the only barrier between the work area and the building exterior, provide translucent, nylon reinforced or woven polyethylene, laminated, flame resistant, polyethylene film that conforms to requirements set forth by the National Fire Protection Association Standard 701, Small Scale Fire Test for Flame-resistant Textiles and Films. Provide largest size possible to minimize seams, 6.0 mil thick, frosted or black as indicated.

2.03 MISCELLANEOUS MATERIALS

- A. Duct Tape: Provide duct tape in 2" or 3" widths as indicated, with an adhesive that is formulated to stick aggressively to sheet polyethylene.
- B. Spray Glue: Provide spray adhesive in aerosol cans which is specifically formulated to stick tenaciously to sheet polyethylene.
- C. Wetting Materials: For wetting prior to disturbance of Asbestos-Containing Materials use either amended water or a removal encapsulant:
 - 1. Amended Water: Provide water to which a surfactant has been added. Use a mixture of surfactant and water which results in wetting of the Asbestos-Containing Material and retardation of fiber release during disturbance of the material equal to or greater than that provided by the use of one ounce of a surfactant consisting of 50% polyoxyethylene ester and 50% polyoxyethylene ether mixed with five gallons of water.
 - 2. Removal Encapsulant: Provide a penetrating type encapsulant designed specifically for removal of Asbestos-Containing Material. Use a material which results in wetting of the Asbestos-Containing Material and retardation of fiber release during disturbance of the material equal to or greater than that provided by water amended with a surfactant consisting of one ounce of a mixture of 50% polyoxyethylene ester and 50% polyoxyethylene ether in five gallons of water.
- D. Disposal Bags: Provide 6 mil thick leak-tight polyethylene bags labeled as required by Article 3.07 of this Section.
- E. Fiberboard Drums: Provide heavy-duty leak tight fiberboard drums with tight sealing locking metal tops.

- F. Paper board Boxes: Provide heavy-duty corrugated paperboard boxes coated with plastic or wax to retard deterioration from moisture. Provide in sizes that will easily fit in disposal bags.

2.04 PROTECTIVE CLOTHING:

- A. Coveralls: Provide disposable full-body coveralls and disposable head covers (Tyvek or approved equal), and require that workers in the Work Area wear them. Provide a sufficient number for required changes, for workers in the Work Area.
- B. Boots: Provide work boots with non-skid soles, and where required by OSHA, foot protection, for workers. Provide boots at no cost to workers. Paint uppers of boots red with waterproof enamel. Do not allow boots to be removed from the Work Area for any reason, after being contaminated with asbestos-containing material. Dispose of boots as asbestos-contaminated waste at the end of the work.
- C. Hard Hats: Provide head protection (hard hats) as required by OSHA for workers, and provide 4 spares for use by Engineer, Project Administrator, and Owner. Label hats with same warning labels as used on disposal bags. Require hard hats to be worn at all times that work is in progress that may potentially cause head injury. Provide hard hats of type with plastic strap type suspension. Require hats to remain in the Work Area throughout the work. Thoroughly clean, decontaminate and bag hats before removing them from Work Area at the end of the work.
- D. Goggles: Provide eye protection (goggles) as required by OSHA for workers involved in scraping, spraying, or any other activity which may potentially cause eye injury. Thoroughly clean, decontaminate and bag goggles before removing them from Work Area at the end of the work.
- E. Gloves: Provide work gloves to workers and require that they be worn at all times in the Work Area Do not remove gloves from Work Area and dispose of as asbestos-contaminated waste at the end of the work.

2.05 AIR PURIFYING RESPIRATORS

- A. Filter Cartridges: Provide, at a minimum, HEPA type filters labeled with NIOSH and MSHA Certification for "Radionuclides, Radon Daughters, Dust, Fumes, Mists including Asbestos-Containing Dusts and Mists" and color coded in accordance with ANSI Z228.2 (1980). In addition, a chemical cartridge section may be added, if required, for solvents, etc., in use. In this case, provide cartridges that have each section of the combination canister labeled with the appropriate color code and NIOSH/MSHA Certification.
- B. Do not use single use, disposable or quarter face respirators.

2.6 ADDITIONAL PROTECTIVE EQUIPMENT

- A. Disposable coveralls, head covers, and footwear covers shall be provided by the Contractor for the Engineer, Owner's Consultant, Project Administrator, and other authorized representatives who have an approved the appropriate respirator and current fit test who may inspect the job site. Provide six complete coveralls and, where applicable, six respirator filter changes per day.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Sequence of Work: Carry out work of this section sequentially. Complete each activity before proceeding to the next.
- B. General:
 1. The work of this part is required for the removal of all types of ACM, including both friable and nonfriable materials, unless otherwise noted.
 2. Work Area: The location where asbestos-abatement work occurs on the project site. . A "Work Area" is considered contaminated during the work, and must be isolated from the balance of the building, and decontaminated at the completion of the asbestos-control work.
 3. Completely isolate the Work Area from other parts of the building so as to prevent asbestos-containing dust or debris from passing beyond the isolated area. Should the area beyond the Work Area(s) become contaminated with asbestos-containing dust or debris as a consequence of the work, clean those areas in accordance with the procedures indicated in Article 3.06 of this Section. Perform such required cleaning or decontamination at no additional cost to owner.
 4. Place tools, scaffolding, staging, etc. necessary for the work in the area to be isolated prior to completion of Work Area isolation.
 5. If required remove furniture out of the Work Area into a temporary storage location the Owner will designate. Also remove uncontaminated equipment, and/or supplies from the Work Area before commencing work, or completely cover with two layers of polyethylene sheeting, at least 6 mil in thickness, securely taped in place with duct tape. Such furniture and equipment shall be considered outside the work area unless covering plastic or seal is breached.
 6. Disable ventilating systems or any other system bringing air into or out of the Work Area. Disable system by disconnecting wires, removing circuit breakers, by lockable switch or other positive means that will prevent accidental premature restarting of equipment.

7. If required to provide a safe work environment lockout power to Work Area by switching off breakers serving power or lighting circuits in work area. Label breakers with tape over breaker with notation "DANGER circuit being worked on." Lock panel and have keys under control of Contractor's Superintendent.
 8. If required to provide a safe work environment lockout power to circuits running through work area wherever possible by switching off breakers or removing fuses serving these circuits. Label breakers with tape over breaker with notation "DANGER circuit being worked on". Lock panel and have keys under control of contractor's superintendent. If circuits cannot be shut down, label at intervals 4'-0" on center with tags reading, "DANGER live electric circuit. Electrocution hazard." Label in a similar manner circuits in hidden locations but which may be affected by the work.
- C. Emergency Exits: At each existing exit door from the Work Area provide the following means for emergency exiting
1. Arrange exit door so that it is secure from outside the Work area but permits exiting from the Work Area.
 2. Mark outline of door on Primary and Critical Barriers with luminescent paint at least 1" wide. Hang a razor knife on a string beside outline. Arrange Critical and Primary barriers so that they can be easily cut with one pass of razor knife. Paint words "EMERGENCY EXIT" inside outline with luminescent paint in letters at least one foot high and 2" thick.
 3. Provide clearly visible/easily distinguished EXIT sign at each exit.
 4. Provide battery-operated emergency lighting that switches on automatically in the event of a power failure.
- D. Control Access:
1. Isolate the Work Area to prevent entry by building occupants into Work Area or surrounding controlled areas. Accomplish isolation by the following:
 - a). Lock doors into Work Area, or, if doors cannot be locked, chain shut. Cover signs that direct emergency exiting, either outside or inside of Work Area, to locked doors. Do not obstruct doors required for emergency exits from Work Area or from building.
 - b). After receiving written authorization from the Engineer construct partitions or closures across any opening into Work Area. Partitions are to be a minimum of 8 feet high.
 - c). Fabricate partitions from 3-5/8", 25 gage metal studs or 2" x 4" wood studs with 1/2" gypsum board on both faces. Brace at 4'-0" on center.

- d). Locked Access: Arrange Work Area so that the only access into Work Area is through lockable doors to personnel and equipment decontamination units.
 - e). Install temporary doors with entrance type locksets that are key lockable from the outside and always unlocked and operable from the inside. Do not use deadbolts or padlocks.
7. Replace locksets or passage sets on doors leading to decontamination units with temporary locksets for duration of the project. Remove any deadbolts or padlocks. Use entry type locksets that are key lockable from outside and always unlocked and operable from inside.
- a). Provide one key for each door to Owner, and Engineer and maintain one key in clean room of decontamination unit (3 total).
8. Visual Barrier: Where the Work Area is immediately adjacent to or within view of occupied areas, provide a visual barrier of opaque polyethylene sheeting at least 6 mil in thickness so that the work procedures are not visible to building occupants. Where this visual barrier would block natural light, substitute frosted or woven rip-stop sheet plastic in locations approved by the Engineer.
9. Provide warning signs at each locked door leading to Work Area reading as follows:

<u>Legend</u>	<u>Notation</u>
KEEP OUT	3" Sans Serif Gothic or Block
BEYOND THIS POINT	1" Sans Serif Gothic or Block
ASBESTOS ABATEMENT WORK	1" Sans Serif Gothic or Block
IN PROGRESS	1" Sans Serif Gothic or Block
BREATHING ASBESTOS DUST MAY BE HAZARDOUS TO YOUR HEALTH	14 Point Gothic

Immediately inside door and outside critical barriers post an approximately 20 inch by 14 inch manufactured caution sign displaying the following legend with letter sizes and styles of a visibility required by 29 CFR 1926:

LEGEND
DANGER
ASBESTOS
CANCER AND LUNG DISEASE HAZARD
RESPIRATORS AND PROTECTIVE CLOTHING ARE REQUIRED
IN THIS AREA

- E. Alternate Methods of Enclosure: Alternate methods of containing the Work Area may be submitted to the Engineer for approval. Do not proceed with any such method(s) without approval of the Engineer.
- F. Respiratory and Worker Protection: Before proceeding beyond this point in providing Temporary Enclosures:
 - 1. Provide Worker Protection per Article 3.2.
 - 2. Provide Respiratory Protection per Article 3.3
 - 3. Provide Personnel Decontamination Unit per Article 3.4.
- G. Critical Barriers:
 - 1. Completely separate the Work Area from other portions of the building and the outside by closing openings with two sheet plastic barriers at least 6 mil in thickness each, and by sealing cracks leading out of Work Area with duct tape.
 - 2. Individually seal ventilation openings (supply and exhaust), lighting fixtures, clocks, doorways, windows, convectors and speakers, and other openings into the Work Area with duct tape alone or with polyethylene sheeting at least 6 mil in thickness, taped securely in place with duct tape. Maintain seal until all abatement work including Project Decontamination is completed. Take care in sealing of lighting fixtures to avoid melting or burning of sheeting.
 - 3. Mechanically support sheet plastic independently of duct tape or spray glue seals so that seals do not support the weight of the plastic. Following are acceptable methods of supporting sheet plastic barriers. Alternative support methods may be used if approved in writing by the Engineer.
 - a. Plywood squares 6" x 6" x 3/8" held in place with one 6d smooth masonry nail or electro-galvanized common nail driven through center of the plywood and duct tape on plastic so that plywood clamps plastic to the wall. Locate plywood squares at each end, corner and at maximum 4 feet on centers.
 - b. Nylon or polypropylene rope or wire with a maximum unsupported span of 10 feet, minimum 1/4" in diameter suspended between supports securely fastened on either side of opening at maximum 1 foot below ceiling. Tighten rope so that it has 2" maximum dip. Drape plastic over rope from outside Work Area so that a two-foot long flap of plastic extends over rope into Work Area. Staple or wire plastic to itself 1" below rope at maximum 6" on centers to form a sheath over rope. Lift flap and seal to ceiling with duct tape or spray cement. Seal loop at bottom of flap with duct tape. Erect entire assembly so that it hangs vertically without a "shelf" upon which debris could collect.

4. Provide Pressure Differential System per Part 3.1 L of this Section.
5. Clean housings and ducts of over spray materials prior to erection of any Critical Barrier that will restrict access.

H. Prepare Area:

1. Scaffolding: If fixed scaffolding is to be used to provide access, HEPA vacuum and wet clean area prior to scaffolding installation.
2. Remove electrical and mechanical items, such as lighting fixtures, clocks, diffusers, and registers that cover any part of the surface to be worked on.
3. Remove general construction items such as cabinets, casework, door and window trim, moldings, ceilings, and trim that cover the surface of the work as required to prevent interference with the work. Clean, decontaminate and reinstall such materials, upon completion of removal work with materials, finishes, and workmanship to match existing installations before start of work.
4. Clean contaminated furniture, equipment, and or supplies with a HEPA filtered vacuum cleaner or by wet cleaning. Remove movable objects out of the Work Area to a temporary storage location designated by the Engineer.
5. Clean surfaces in Work Area with a HEPA filtered vacuum or by wet wiping prior to the installation of primary barrier.

I. Primary Barrier:

1. Protect building and other surfaces in the Work Area from damage from water and high humidity and from contamination from asbestos-containing debris, slurry or high airborne fiber levels by covering with a primary barrier as described below.
2. Sheet Plastic: Protect surfaces in the Work Area with two layers of plastic sheeting on floors, ceilings and walls, or as otherwise directed by the Owner's Inspection and Testing Agency. Perform work in the following sequence.
 - a. Cover Floor of Work Area with 2 individual layers of clear polyethylene sheeting (except where floor tile or soil abatement is occurring), each at least 6 mil in thickness, turned up walls at least 12 inches. Form a sharp right angle bend at junction of floor and wall so that there is no radius that could be stepped on causing the wall attachment to be pulled loose. Both spray-glue and duct tape seams in floor covering. Locate seams in top layer six feet from, or at right angles to, seams in bottom layer. Install sheeting so that top layer can be removed independently of bottom layer.
 - b. Cover walls in Work Area including "Critical Barrier" sheet plastic barriers with two layers of polyethylene sheeting at least 6 mils in thickness,

mechanically supported and sealed with duct tape or spray-glue in the same manner as described above for "critical barriers. Tape joints including the joining with the floor covering with duct tape or as otherwise indicated on the Contract Documents or in writing by the Engineer.

- c. Similarly, cover suspended ceiling tile, acoustical plaster ceiling, and other ceilings with a porous surface, with a minimum of one layer of polyethylene sheeting, at least 6 mil in thickness.
 - d. Repair of Damaged Polyethylene Sheeting: Remove and replace plastic sheeting that has been damaged by removal operations or where seal has failed allowing water to seep between layers. Remove affected sheeting and wipe down entire area. Install new sheet plastic only when area is completely dry.
- J. Stop Work: If the Critical or Primary barrier falls or is breached in any manner stop work immediately. Do not start work until authorized to resume work by the Engineer.
- K. Exterior Enclosures: Construct exterior enclosures as a Critical Barrier as necessary to completely enclose the work. Fabricate from reinforced polyethylene sheeting and 2"x4" wood framework. Attach to existing building components or brace as necessary for lateral stability. Construct walls to meet state and local regulations for construction of temporary buildings.
- L. Pressure Differential Isolation:
- 1. Isolate the Work Area from adjacent areas or systems of the building with a Pressure Differential that will cause a movement of air from outside to inside at any breach in the physical isolation of the Work Area.
 - 2. Relative Pressure in Work Area: Continuously maintain the work area at an air pressure that is lower than that in any surrounding space in the building, or at any location in the immediate proximity outside of the building envelope. This pressure differential when measured across any physical or critical barrier must equal or exceed a static pressure of:
 - 0.02 inches of water.Install manometer and related tubing to continuously measure pressure differential.
 - 3. Accomplish the pressure differential by exhausting a sufficient number of HEPA filtered fan units from the work area. The number of units required will depend on machine characteristics, the seal at barriers, and required air circulation. The number of units will increase with increased make-up air or leaks into the Work Area. Determine the number of units required for pressure isolation by the following procedure:

- a. Establish required air circulation in the work area, personnel and equipment decontamination units.
 - b. Establish isolation by increased pressure in adjacent areas or as part of seals where required.
 - c. Exhaust a sufficient number of units from the work area to develop the required pressure differential.
4. The required number of units is the number determined above plus one additional unit.
 5. Vent HEPA filtered fan units to outside of building unless authorized in writing by Engineer.
 - a. Mount units to exhaust directly or through disposable ductwork.
 - b. Use only new ductwork except for sheet metal connections and elbows.
 - c. Use ductwork and fittings of same diameter or larger than discharge connection on fan unit.
 - d. Use inflatable, disposable plastic ductwork in lengths not greater than 100 feet.
 - e. Use spiral wire-reinforced flex duct in lengths not greater than 50 feet.
 - f. Arrange exhaust as required to inflate duct to rigidity sufficient to prevent flapping.
 - g. If direction of discharge from fan unit is not aligned with duct use sheet metal elbow to change direction. Use six feet of spiral wire reinforced flex duct after direction change.

M. Air Circulation in the Work Area:

1. Air Circulation: For purposes of this section air circulation refers to either the introduction of outside air to the Work Area or the circulation and cleaning of air within the Work Area.
2. Air circulation in the Work Area is a minimum requirement intended to help maintain airborne fiber counts at a level that does not significantly challenge the work area isolation measures. The Contractor may also use this air circulation as part of the engineering controls in his worker protection program.
3. Determining the Air circulation Requirements: Provide a fully operational air circulation system supplying a minimum of 4 air changes per hour.
4. Add one (1) additional unit as a backup in case of equipment failure or machine shutdown for filter changing.

- N. Exhaust System: Pressure differential isolation and air circulation in the Work Area are to be accomplished by an exhaust system as described below.
1. Exhaust units from the Work Area to meet air circulation requirement of this section.
 2. Location of HEPA Filtered Fan Units: Locate fan unit(s) so that makeup air enters work area primarily through decontamination facilities and traverses Work Area as much as possible. This may be accomplished by positioning the HEPA filtered fan unit(s) at a maximum distance from the worker access opening or other makeup air sources.
 3. Vent to outside of building, unless authorized in writing by the Engineer.
 4. Decontamination Units: Arrange Work Area and decontamination units so that the majority of make up air comes through the Decontamination Units. Use only personnel or equipment Decontamination Unit at any time and seal the other so that make up air passes through unit in use.
 5. Supplemental Makeup Air Inlets: Provide where required for proper air flow through the Work Area in location approved by the Engineer by making openings in the plastic sheeting that allow air from outside the building into the Work Area. Locate auxiliary makeup air inlets as far as possible from the fan unit(s) (e.g., on an opposite wall), off the floor (preferably near the ceiling), and away from barriers that separate the Work Area from occupied clean areas. Cover with flaps to reseal automatically if the pressure differential system should shut down for any reason. Spray flap and around opening with spray adhesive so that if flap closes meeting surfaces are both covered with adhesive. Use adhesive that forms contact bond when dry.
- O. Recirculation System: Pressure differential isolation and air circulation in the Work Area are to be accomplished by a recirculation system as described below.
1. Recirculate air in the Work Area through HEPA filtered fan units to accomplish air circulation requirements of this section.
 2. Location of Fan Units: Locate HEPA filtered fan units so that air is circulated through all parts of the Work Area, and so that required pressure is maintained at all parts of Work Area geometry. Move units as necessary so that in any location where asbestos-containing materials are being disturbed the discharge from one HEPA filtered fan unit is blowing contamination away from workers. Direct airflow in these locations so that it is predominantly toward workers' backs at the breathing zone elevation.

P. Use of the Pressure Differential and Air Circulation System:

1. General: Each unit shall be serviced by a dedicated minimum 115V-20A circuit with ground fault circuit interrupter (GFCI) supplied from temporary power supply installed by the Contractor's licensed electrician. Do not use existing branch circuits to power fan units.
2. Testing the System: Test pressure differential system before any asbestos-containing material is wetted or removed. After the Work Area has been prepared, the decontamination facility set up, and the fan unit(s) installed, start the unit(s) (one at a time). Demonstrate operation and testing of pressure differential system to Engineer.
3. Demonstrate Condition of Equipment for each HEPA filtered fan unit and pressure differential monitoring equipment including proper operation of the following:
 - a. Squareness of HEPA Filter
 - b. Condition of Seals
 - c. Proper operation of lights
 - d. Proper operation of automatic shut down if exhaust is blocked
 - e. Proper operation of alarms
 - f. Proper operation of magnehelic gauge
 - g. Proper operation and calibration on pressure monitoring equipment
4. Demonstrate Operation of the pressure differential system to the Engineer will include, but not be limited to, the following:
 - a. Plastic barriers and sheeting move lightly in toward Work Area.
 - b. Curtain of decontamination units moves lightly in toward Work Area.
 - c. There is a noticeable movement of air through the Decontamination Unit.
 - c. Use smoke tube to demonstrate air movement from Clean Room through Shower Room to Equipment Room.
 - e. Use smoke tubes to demonstrate a definite motion of air across all areas in which work is to be performed.
 - f. Use a differential pressure meter or manometer to demonstrate the required pressure differential at every barrier separating the Work Area from the balance of the building, equipment, duct work or outside.
5. Modify the Pressure Differential System as necessary to demonstrate successfully the above.
6. Use of System during Abatement Operations:
 - a. Start fan units before beginning work (before any asbestos-containing material is disturbed). After abatement work has begun, run units continuously to maintain a constant pressure differential and air circulation until

decontamination of the work area is complete. Do not turn off units at the end of the work shift or when abatement operations temporarily stop.

- b. Do not shut down air pressure differential system during encapsulating procedures, unless authorized by the Engineer in writing. Supply sufficient pre-filters to allow frequent changes.
 - c. Start abatement work at a location farthest from the fan units and proceed toward them. If an electric power failure occurs, immediately stop all abatement work and do not resume until power is restored and fan units are operating again.
 - d. At completion of abatement work, allow fan units during final cleaning sequence to remove airborne fibers that may have been generated during abatement work and cleanup and to purge the Work Area with clean makeup air. The units may be required to run for a longer time after decontamination, if dry or only partially wetted asbestos material was encountered during any abatement work.
7. Dismantling the System: When a final inspection and the results of final air tests indicate that the area has been decontaminated, fan units may be removed from the Work Area. Before removal from the Work Area, remove and properly dispose of pre-filter, decontaminate exterior of machine and seal intake to the machine with 6-mil polyethylene to prevent environmental contamination from the filters.

3.02 WORKER PROTECTION AND DECONTAMINATION PROCEDURES

- A. The work of this part is required for the removal or other abatement of all types of ACM, including both friable and nonfriable materials unless otherwise noted.
- B. Provide worker protection as required by the most stringent OSHA and/or EPA standards applicable to the work. The following procedures are minimums to be adhered to regardless of fiber count in the Work Area.
- C. Each time Work Area is entered remove street clothes in the Changing Room of the Personnel Decontamination Unit and put on new disposable coverall, new head cover, and a clean respirator. Proceed through shower room to equipment room and put on work boots.
- D. Require workers to adhere to the following personal decontamination procedures whenever they leave the Work Area:
 1. When exiting area, remove disposable coveralls, disposable head covers, and disposable footwear covers or boots in the equipment room.

2. Still wearing respirators, proceed to showers. Showering is mandatory. Care must be taken to follow reasonable procedures in removing the respirator to avoid asbestos fibers while showering. The following procedure is required as a minimum:
3. Thoroughly wet body including hair and face. If using a Powered Air-Purifying Respirator (PAPR) hold blower unit above head to keep canisters dry.
4. With respirator still in place thoroughly wash body, hair, respirator face piece, and all parts of the respirator except the blower unit and battery pack on a PAPR. Pay particular attention to seal between face and respirator and under straps.
5. Take a deep breath, hold it and/or exhale slowly, completely wet hair, face, and respirator. While still holding breath, remove respirator and hold it away from face before starting to breath.
6. Carefully wash face piece of respirator inside and out.
7. If using PAPR, shut down in the following sequence, first cap inlets to filter cartridges, then turn off blower unit (this sequence will help keep debris which has collected on the inlet side of filter from dislodging and contaminating the outside of the unit). Thoroughly wash blower unit and hoses. Carefully wash battery pack with wet rag. Be extremely cautious of getting water in battery pack as this will short out and destroy battery.
8. Dispose of wet filters from air purifying respirator.
9. Rinse thoroughly.
10. Rinse shower room walls and floor prior to exit.
11. Proceed from shower to Changing Room and change into street clothes or into new disposable work clothes.

- E. Within Work Area: Require that workers NOT eat, drink, smoke, chew tobacco or gum, or apply cosmetics in the Work Area. To eat, chew, drink or smoke, workers shall follow the procedure described above, and then dress in street clothes before entering the non-Work Areas of the building.

3.03 RESPIRATORY PROTECTION

- A. Require that respiratory protection be used at all times that there is any possibility of disturbance of asbestos-containing materials whether intentional or accidental.
- B. Require that a respirator be worn by anyone in a Work Area at all times, regardless of activity, during a period that starts with any operation which could cause airborne fibers until the area has been cleared for re-occupancy in accordance with Article 1.10 of this Section.

- C. Regardless of Airborne Fiber Levels: Require that the minimum level of respiratory protection used be half-face air-purifying respirators with high efficiency filters.
- D. Do not allow the use of single-use, disposable, or quarter-face respirators for any purpose.
- E. Fit Testing:
 - 1. Initial Fitting: Provide initial fitting of respiratory protection during a respiratory protection course of training set up and administered by a Certified Industrial Hygienist. Fit types of respirator to be actually worn by each individual. Allow an individual to use only those respirators for which training and fit testing has been provided.
 - 2. On a Weekly Basis, check the fit of each worker's respirator by having irritant smoke blown onto the respirator from a smoke tube.
 - 3. Upon Each Wearing: Require that each time an air-purifying respirator is put on it be checked for fit with a positive and negative pressure fit test in accordance with the manufacturer's instructions or ANSI Z88.2 (1980).
- F. Type of Respiratory Protection Required: Provide respiratory protection as indicated in accordance with OSHA requirements. In the event that an initial exposure assessment has previously been conducted, determine the proper level of protection by dividing the expected or actual airborne fiber count in the Work Area by the appropriate "protection factors" specified by OSHA for various types of respirators. The level of respiratory protection that supplies an airborne fiber level inside the respirator, at the breathing zone of the wearer, at or below the permissible exposure limit (PEL) is the minimum level of protection allowed.
- G. Permissible Exposure Limit (PEL):
 - 1. 8-Hour Time Weighted Average (TWA) of asbestos fibers to which any worker may be exposed shall not exceed 0.1 fiber/cc.
 - 2. 8-Hour Time Weighted Average (TWA) and Ceiling Concentration of asbestos fibers based on a 30 minute period to which any worker may be exposed shall not exceed 1.0 fiber/cc.
 - 3. Contractor must assess asbestos operations for their potential to generate airborne fibers. Contractor must use exposure-monitoring data to assess worker exposures.
 - 4. Fibers: For purposes of this section, fibers are defined as all fibers regardless of composition as counted in the OSHA Reference Method (ORM), or NIOSH 7400 procedure.

L. Air Purifying Respirators:

1. Negative pressure - half or full-face mask: Supply a sufficient quantity of respirator filters approved for asbestos, so that workers can change filters during the workday. Require that respirators be wet-rinsed, and filters discarded, each time a worker leaves the Work Area. Require that new filters be installed each time a worker re-enters the Work Area. Store respirators and filters at the job site in the changing room and protect totally from exposure to asbestos prior to their use.
2. Powered air purifying - half or full face mask: Supply a sufficient quantity of high efficiency respirator filters approved for asbestos so that workers can change filters at any time that flow through the face piece decreases to the level at which the manufacturer recommends filter replacement. Require that regardless of flow, filter cartridges be replaced after 40 hours of use. Require that HEPA elements in filter cartridges be protected from wetting during showering. Require entire exterior housing of respirator, including blower unit, filter cartridges, hoses, battery pack, face mask, belt, and cords, be washed each time a worker leaves the Work Area. Caution should be used to avoid shorting battery pack during washing. Provide an extra battery pack for each respirator so that one can be charging while one is in use.

M. Type "C" Respirator: Continuously monitor the air system operation including compressor operation, filter system operation, backup air capacity and warning and monitoring devices at all times that system is in operation. Assign an individual, trained by manufacturer of the equipment in use or by a Certified Industrial Hygienist, in the operation and maintenance of the system to provide this monitoring. Assign no other duties to this individual that will take him away from monitoring the air system.

3.04 DECONTAMINATION UNITS

A. Personnel Decontamination Unit: Provide a Personnel Decontamination Unit consisting of a serial arrangement of connected rooms or spaces, Clean Room, Shower Room, Equipment Room with airlocks between spaces. Require all persons without exception to pass through this Decontamination Unit for entry into and exiting from the Work Area for any purpose. Do not allow parallel routes for entry or exit. Do not remove equipment or materials through Personnel Decontamination Unit. Provide temporary lighting within Decontamination Units as necessary to reach a lighting level of 100-foot candles.

1. Changing Room (clean room): Provide a room that is physically and visually separated from the rest of the building for the purpose of changing into protective clothing.
 - a. Construct using polyethylene sheeting, at least 6 mil in thickness, to provide an airtight seal between the Changing Room and the rest of the building.

- b. Locate so that access to Work Area from Changing Room is through Shower Room.
 - c. Separate Changing Room from the building by a sheet plastic flapped doorway.
 - d. Require workers to remove street clothes in this room, dress in clean, disposable coveralls, and don respiratory protection equipment. Do not allow asbestos-contaminated items to enter this room. Require Workers to enter this room either from outside the structure dressed in street clothes, or naked from the showers.
 - e. An existing room may be utilized as the Changing Room if it is suitably located and of a configuration whereby workers may enter the Changing Room directly from the Shower Room. Protect surfaces of room with sheet plastic as set forth in Temporary Enclosures. Authorization for this must be obtained from the Engineer in writing prior to start of construction.
 - f. Maintain floor of changing room dry and clean at all times. Do not allow overflow water from shower to wet floor in changing room.
 - g. Damp wipe surfaces twice after each shift change with a disinfectant solution.
 - h. Provide posted information for emergency phone numbers and procedures.
2. Airlocks: Provide an airlock between Clean Room and Shower Room and an airlock (3' minimum) between shower room and equipment room.
3. Shower Room: Provide a completely watertight operational shower to be used for transit by cleanly dressed workers heading for the Work Area from the Changing Room, or for showering by workers headed out of the Work Area after undressing in the Equipment Room.
- a. Construct room by providing a shower pan and 2 shower walls in a configuration that will cause water running down walls to drip into pan. Install a freely draining wooden floor in shower pan at elevation of top of pan.
 - b. Separate this room from the rest of the building with airtight walls fabricated of two layers of 6-mil polyethylene.
 - c. Provide showerhead and controls.
 - d. Provide temporary extensions of existing hot and cold water and drainage, as necessary for a complete and operable shower.
 - e. Provide a soap dish and a continuously adequate supply of soap and maintain in sanitary condition.
 - f. Arrange so that water from showering does not splash into the Changing or Equipment Rooms.

- g. Arrange water shut off and drain pump operation controls so that a single individual can shower without assistance from either inside or outside of the Work Area.
 - h. Provide flexible hose shower head.
 - i. Pump waste water to drain or to storage for use in amended water. If pumped to drain, provide 20 micron and 5 micron wastewater filters in line to drain or waste water storage. Change filters daily or more often if necessary. Locate filters inside shower unit so that water lost during filter changes is caught by shower pan.
 - j. Provide hose bib.
4. Equipment Room (contaminated area): Require work equipment, footwear and additional contaminated work clothing to be left here. This is a change and transit area for workers.
- a. Separate this room from the rest of the building with airtight walls fabricated of two layers of 6-mil polyethylene.
 - b. Provide a drop cloth layer of sheet plastic on floor in the Equipment Room for every shift change expected. Roll drop cloth layer of plastic from Equipment Room into Work Area after each shift change. Replace before next shift change. Provide a minimum of two (2) layers of plastic at all times. Use only clear plastic to cover floors.

B. Equipment Decontamination Unit:

- 1 Provide an Equipment Decontamination Unit consisting of a serial arrangement of rooms, Clean Room, Holding Room, Wash Room for removal of equipment and material from Work Area. Do not allow personnel to enter or exit Work Area through Equipment Decontamination Unit.
2. Wash Down Station: Provide an enclosed Shower Unit located in Work Area just outside Wash Room as an equipment, bag and container cleaning station.
 - a. Fabricate waterproof floor extending 6'.0" beyond Wash Down station in all directions. Install seamless waterproof membrane over area and extend over curbs on all four sides. Form curbs from 2" x 4" lumber laid on the flat.
 - b. Waterproof membrane shall be fabricated from elastomeric membrane or 10 mil polyethylene, minimum.
 - c. Do not allow water to collect on waterproof membrane. Remove continuously with a wet vacuum or mops.
3. Wash Room: Provide washroom for cleaning of bagged or containerized asbestos-containing waste materials passed from the Work Area.

- a. Construct wash room of nominal 2" x 4" wood framing and polyethylene sheeting, at least 6 mil in thickness and located so that packaged materials, after being wiped clean, can be passed to the Holding Room.
 - b. Separate this room from the Work Area by a single flapped door of 6-mil polyethylene sheeting.
 - c. Provide a drop cloth layer of plastic on floor in the Wash Room for every load-out operation. Roll this drop cloth layer of plastic from Wash Room into Work Area after each load-out. Provide a minimum of two (2) layers of plastic at all times. Use only clear plastic to cover floors.
4. Airlock: Provide an airlock (4' minimum) between Wash Room and Holding Room. This is a transit area.
 - a. Separate this room from adjacent spaces by a sheet plastic flapped doorway.
 - b. Separate this room from the rest of the building and adjacent spaces with airtight walls fabricated of two layers of 6-mil polyethylene.
5. Holding Room: Provide Holding Room as a drop location for bagged asbestos-containing materials passed from the Wash Room. Construct Holding Room of nominal 2" x 4" wood framing and polyethylene sheeting, at least 6 mil in thickness and located so that bagged materials cannot be passed from the Wash Room through the Holding Room to the Clean Room.
 - a. Separate this room from the adjacent rooms by flap doors fabricated from 6-mil sheet plastic.
6. Airlock: Provide an airlock (4' minimum) between Holding Room and Clean Room. This is a transit area.
 - a. Separate this room from adjacent spaces by a sheet plastic flap doorway.
 - b. Separate this room from the rest of the building and adjacent spaces with airtight walls fabricated of two layers of 6-mil polyethylene.
7. Clean Room: Provide Clean Room to isolate the Holding Room from the building exterior. If possible locate to provide direct access to the Holding Room from the building exterior.
 - a. Erect Critical and Primary Barriers as described herein in an existing space. If no space exists construct Clean Room of 2"x 4" wood framing and polyethylene sheeting, at least 6 mil in thickness.
 - b. Separate this room from the exterior by a single flap door of 6-mil polyethylene sheeting.
8. Load-out Area: The load-out area is the transfer area from the building to a truck or dumpster. It may be the Clean Room of the Equipment Decontamination unit

or a separate room or loading dock area. Erect Critical and Primary barriers as described in Part 3.1 in load-out area.

- a. During transfer of material from load-out area erect primary barriers as described in Part 3.1 as necessary to seal path from load-out area to truck or dumpster.

C. Decontamination Sequence: Take equipment or material from the Work Area through the Equipment Decontamination Unit according to the following procedure:

1. At wash down station, thoroughly wet clean contaminated equipment or sealed polyethylene bags and pass into Wash Room.
2. When passing equipment or containers into the Wash Room, close doorways of the Equipment Decontamination Unit, other than the doorway between the Wash down Station and the Wash Room. Keep outside personnel clear of the Equipment Decontamination Unit.
3. Once inside the washroom, wet clean the bags and/or equipment.
4. When cleaning is complete pass items into Holding Room. Close doorways except the doorway between the Holding room and the Clean Room.
5. Workers from the building exterior enter Holding Area and remove decontaminated equipment and/or containers for disposal.
6. Require these workers to wear full protective clothing and appropriate respiratory protection.
7. At no time is a worker from an uncontaminated area to enter the enclosure when a removal worker is inside.

D. Construction of the Decontamination Units:

1. Walls and Ceiling: Construct airtight walls and ceiling using 2 layers (minimum) of polyethylene sheeting, at least 6 mil in thickness. Attach to existing building components or a temporary framework.
2. Floors: Use 2 layers (minimum) of 6-mil polyethylene sheeting to cover floors in all areas of the Decontamination Units. Use only clear plastic to cover floors.
3. Flap Doors: Fabricated from three (3) overlapping sheets with openings a minimum of three feet (3') wide. Configure so that sheeting overlaps adjacent surfaces. Weigh sheets at bottoms as required so that they quickly close after being released. Put arrows on sheets to indicate direction of overlap and/or travel. Provide a minimum of six feet (6') between entrance and exit of any room. Provide a minimum of three feet (3') between doors to airlocks.

- a. If the Decontamination area is located within an area containing friable asbestos on overhead ceilings, ducts, piping, etc., provide the area with a minimum 1/4 inch hardboard or 1/2 inch plywood "ceiling" with 2 layers, minimum, polyethylene sheeting, at least 6 mil in thickness covering the top of the "ceiling".
4. Visual Barrier: Where the Decontamination area is immediately adjacent to and within view of occupied areas, provide a visual barrier of opaque polyethylene sheeting at least 6 mil in thickness so that worker privacy is maintained and work procedures are not visible to building occupants. Where the area adjacent to the Decontamination area is accessible to the public, construct a solid barrier on the public side of the sheeting to protect the sheeting. Construct barrier with wood or metal studs covered with minimum 1/4-inch thick hardboard or 1/2-inch plywood. Where the solid barrier is provided, sheeting need not be opaque.
 - b. Alternate methods of providing Decontamination facilities may be submitted to the Engineer for approval. Do not proceed with any such method(s) without written authorization of the Engineer.
5. Electrical: Provide sub panel at Changing Room to accommodate removal equipment. Power sub panel directly from a building electrical panel. Connect electrical branch circuits in Decontamination unit and particularly any pumps in shower room to a ground-fault circuit protection device.
- E. Cleaning of Decontamination Units: Clean debris and residue from inside of Decontamination Units on a daily basis or as otherwise indicated on Contract Drawings. Damp wipe or hose down all surfaces after each shift change. Clean debris from shower pans on a daily basis.
- F. Signs:
 1. Post an approximately 20 inch by 14 inch manufactured caution sign at each entrance to the Work Area displaying the following legend with letter sizes and styles of a visibility required by 29 CFR 1926.1101.

LEGEND

DANGER

ASBESTOS

CANCER AND LUNG DISEASE HAZARD
RESPIRATORS AND PROTECTIVE CLOTHING ARE REQUIRED
IN THIS AREA

- a. Provide signs in both English and Spanish.

- b. Provide spacing between respective lines at least equal to the height of the respective upper line.
2. Post an approximately 10 inch by 14 inch manufactured sign at each entrance to each Work Area displaying the following legend with letter sizes and styles of a visibility at least equal to the following:

<u>LEGEND</u>	<u>NOTATION</u>
NO FOOD, BEVERAGES OR TOBACCO PERMITTED	3/4" Block
ALL PERSONS SHALL DON PROTECTIVE CLOTHING (COVERINGS) BEFORE ENTERING THE WORK AREA	3/4" Block
ALL PERSONS SHALL SHOWER IMMEDIATELY AFTER LEAVING WORK AREA AND BEFORE ENTERING THE CHANGING AREA	3/4" Block

3.05 ASBESTOS REMOVAL

A. Pre-work inspection

- 1. Do not begin any work in any abatement work area until the Contractor's third party Inspection and Testing Agency has performed a pre-work inspection. It is the Contractor's responsibility to notify the Owner of their schedule and anticipated dates for the pre-work inspection.
- 2. Inspection will be performed to assure all work area preparations are in place, as described herein. Any deficiencies in work area preparations will be corrected at this time. Work may not proceed until the Contractor receives written authorization from the on-site representative of the Testing Agency.

B. Wet Removal:

- 1. Thoroughly wet Asbestos-Containing Materials to be removed prior to stripping to reduce fiber dispersal into the air. Accomplish wetting by a fine spray (mist) of amended water or removal encapsulant. Saturate material sufficiently to wet to the substrate without causing excess dripping. Allow time for amended water or removal encapsulant to penetrate material thoroughly. If amended water is used, spray material repeatedly during the work process to maintain a continuously wet condition. If a removal encapsulant is used, apply in strict accordance with manufacturer's written instructions.

2. Mist work area continuously with amended water whenever necessary to reduce airborne fiber levels.
 3. Remove intact, saturated Asbestos-Containing Material in small sections from all areas. Do not allow material to dry out. Lower ACM to ground—do not drop ACM from any height. As it is removed, simultaneously package material while still wet into disposal bags or other appropriate waste container. Twist neck of bags, bend over and seal with minimum three wraps of duct tape.
 4. Evacuate air from disposal bags with a HEPA filtered vacuum cleaner before sealing.
- C. Clean substrate from which ACM was removed by wet wiping and using a HEPA vacuum until no visible debris remains.
- D. Encapsulation of Substrate: Perform encapsulation of substrate to lockdown any nonvisible fibers that may be remaining.

3.06 WORK AREA DECONTAMINATION

- A. General: Decontamination of the Work Area following asbestos abatement.
1. If the asbestos abatement work is on damaged or friable materials the work is a three-step procedure with two cleanings of the Primary Barrier plastic prior to its removal and one cleaning of the room surfaces to remove any new or existing contamination. Unless specifically indicated otherwise all materials are considered damaged or friable for purposes of this section.
 2. If the asbestos abatement work is on undamaged, nonfriable materials that have not been rendered friable, the decontamination procedure is a two-step procedure with two cleanings of the Primary Barrier plastic to remove contamination, thus preventing contamination of the building when the Work Area isolation barriers are removed.
 3. In both cases operation of the pressure differential system is used to remove airborne fibers generated by the abatement work.
- B. Start of Work: Work of this part begins with the cleaning of the Primary Barrier. At start of work the following will be in place:
1. Primary Barrier: Two layers of polyethylene sheeting on floor and one layer on walls.
 2. Critical Barrier: An airtight barrier between the Work Area and other portions of the building or the outside.
 3. Critical Barrier Sheeting: Over lighting fixtures and clocks, ventilation openings, doorways, convectors, speakers and other openings.

4. Decontamination Units: For personnel and equipment in operating condition.
 5. Pressure Differential System: In operation.
- C. First Cleaning: Carry out a first cleaning of all surfaces of the work area including items of remaining sheeting, tools, scaffolding and/or staging by use of damp-cleaning and mopping, and/or a High Efficiency Particulate Air (HEPA) filtered vacuum. (Note: A HEPA vacuum may fail if used with wet material.) Do not perform dry dusting or dry sweeping. Use each surface of a cleaning cloth one time only and then dispose of as contaminated waste. Continue this cleaning until there is no visible debris from removed materials or residue on plastic sheeting or other surfaces.
- D. Remove Filters in Air Handling System(s) and dispose of as asbestos-containing waste in accordance with requirements of Part 3.08 of this Section.
- E. Wait 96 air changes to allow HEPA filtered fan units to clean air of airborne asbestos fibers. Use oscillating fans as necessary to assure circulation of air in all parts of work areas during this period. Maintain Pressure Differential System in operation for the entire 96-air change period.
- F. Second Cleaning: Carry out a second cleaning of all surfaces in the work area in the same manner as the first cleaning.
- G. Encapsulation of substrate: Perform encapsulation of substrate at this time. Maintain Pressure Differential System in operation during encapsulation work. Perform work only after meeting the following requirements:
1. Surfaces to be covered have met the requirements for a visual inspection in this section.
 2. Airborne fiber counts in the Work Area are at or below 0.01 fibers per cubic centimeter as measured by phase contrast microscopy.
- H. Removal of Primary Barriers: Immediately following the second cleaning of the Primary plastic, remove Primary Barrier sheeting and Material Decontamination Unit, if there is one, leaving only:
1. Critical Barrier: Which forms the sole barrier between the Work Area and other portions of the building or the outside.
 2. Critical Barrier Sheeting: Over lighting fixtures and clocks, ventilation openings, doorways, convectors, speakers, and other openings.
 3. Decontamination Unit: For personnel, in operating condition.
 4. Pressure Differential System: Maintain in continuous operation.

- I. Final cleaning: Carry out a final cleaning of all surfaces in the work area in the same manner as the first cleaning immediately after removal of Primary plastic. This cleaning is now being applied to existing room surfaces. Take care to avoid watermarks or other damage to surfaces.
- J. Contractor's Testing: At the completion of the above cleaning visually inspect all surfaces. Reclean if any dust, debris, etc. is found. At completion of this inspection sweep entire Work Area including walls, ceilings, ledges, floors and other surfaces in the Work Area with exhaust from forced-air equipment (leaf blower with approximately 1 horsepower electric motor or equivalent). Do not direct forced-air equipment at any seal in any Critical Barrier. If any debris or dust is found repeat the cleaning. Continue this process until no debris dust or other material is found while sweeping of all surfaces with forced-air equipment.
- K. Wait 48 air changes to allow HEPA filtered fan units to clean air of airborne asbestos fibers. Use oscillating fans as necessary to assure circulation of air in all parts of work areas during this period. Maintain pressure differential system in operation for the entire 48-air change period.
- L. After final cleaning perform a complete visual inspection of the entire Work Area including: all surfaces, ceiling, walls, floor, decontamination unit, plastic sheeting, seals over ventilation openings, doorways, windows, and other openings; look for debris from any sources, residue on surfaces, dust or other matter. During visual inspection sweep entire work area including walls, ceilings, ledges, floors, and other surfaces in the room with exhaust from forced air equipment (leaf blower with approximately 1 horsepower electric motor or equivalent). If any debris, residue, dust or other matter is found repeat final cleaning and continue decontamination procedure from that point. When the area is visually clean, and if after sweeping of all surfaces with leaf blower, no debris, residue, dust or other material is found, complete the certification at the end of this section. Visual inspection is not complete until confirmed in writing, on the certification, by Project Administrator.
- M. Temporary Lighting: Provide a minimum of 100-foot candles of lighting on all surfaces in the areas to be subjected to visual inspection. Provide hand held lights providing 150-foot candles at 4 feet capable of reaching all locations in work area.
- N. Final Air Sampling PCM:
 - 1. After the work area is found to be visually clean, air samples will be taken and analyzed in accordance with the procedure for PCM, as applicable, set forth in Article 1.10 of this Section.
 - 2. If Release Criteria are not met, repeat Final Cleaning and continue Decontamination Procedure from that point. Contractor will bare cost for additional air testing if first set fails.

3. If Release Criteria are met, proceed to work of this Section on Removal of Work Area Isolation.

O. Encapsulation of Substrate: Perform encapsulation of substrate or installation of spray-applied finishes or fireproofing, where required, before Removal of Work Area Isolation as specified below. Maintain Pressure Differential System in operation during encapsulation work.

3.07 DISPOSAL OF ASBESTOS WASTE

A. Disposal Bags or Polyethylene Sheet Wrapping: Provide 12 mil thick, in total, leak-tight polyethylene bags or sheet wrapping, to contain all waste. On outermost layer, apply four (4) labels with text as follows:

1. First Label:

CAUTION
CONTAINS ASBESTOS FIBERS
AVOID OPENING OR BREAKING CONTAINER
BREATHING ASBESTOS IS HAZARDOUS TO YOUR HEALTH

2. Second Label: Provide in accordance with 29 CFR 1910.1200(f) of OSHA's Hazard Communication standard:

DANGER
CONTAINS ASBESTOS FIBERS
AVOID CREATING DUST
CANCER AND LUNG DISEASE HAZARD
BREATHING AIRBORNE ASBESTOS, TREMOLITE, ANTHOPHYLLITE, OR
ACTINOLITE FIBERS IS HAZARDOUS TO YOUR HEALTH

3. Third Label: Provide in accordance with U.S. Department of Transportation regulation on hazardous waste marking. 49 CFR parts 171 and 172. Hazardous Substances: Final Rule. Published November 21, 1986 and revised February 17, 1987:

RQ HAZARDOUS
SUBSTANCE,
SOLID, NOS,
ORM-E, NA 9188
(ASBESTOS)

4. Fourth Label: Provide in accordance with U.S. Department of Environmental Protection Regulation of the National Emission Standards for Hazardous Air Pollutants 40 CFR Part 61.150(v) Asbestos NESHAP Revision, Final rule published November 20, 1990.

City of Framingham
Worcester Road Sewer Pumping Station
Framingham, Massachusetts

- B. Carefully load containerized waste in fully enclosed dumpsters, trucks or other appropriate fully enclosed vehicles for transport. Exercise care before and during transport, to insure that no unauthorized persons have access to the material.
 - 1. Do not store containerized materials outside of the Work Area. Take containers from the Work Area directly to an approved facility or Temporary Asbestos Containing Waste Material Storage Location (TASL). Waste is to be removed from the TASL within 30-days of the date of removal.
 - 2. Do not transport disposal bagged materials on open trucks. Label drums with same warning labels as bags. Uncontaminated drums may be reused. Treat drums that have been contaminated as asbestos-containing waste and dispose of in accordance with this specification.
- C. Employ a waste hauler with required licenses from state and local authority with jurisdiction to haul the waste from the abatement work.
- D. Dispose of waste in a landfill that accepts asbestos waste materials. Advise the landfill operator or processor, at least ten days in advance of transport, of the quantity of material to be delivered. All waste shall be delivered to only **one** landfill.
- E. At disposal site unload containerized waste. At a disposal site, sealed plastic bags may be carefully unloaded from the truck. If bags are broken or damaged, return to work site for rebagging. Clean entire truck and contents, as appropriate.
- F. Retain receipts from landfill or processor for materials disposed.
- G. At completion of hauling and disposal of each load, submit copy of waste shipment record (WSR) and landfill receipt to the Engineer. The WSR must be returned to the Engineer in no more than 35 days.

3.08 REMOVAL OF WORK AREA ISOLATION:

- A. Perform work specified in this article only after all requirements of this Section and Work Area Clearance have been met:
- B. Remove the Critical Barriers separating the Work Area from the rest of the building. Remove any small quantities of residual material found upon removal of the plastic sheeting with wet wiping, HEPA filtered vacuum cleaners and local area protection. If significant quantities, as determined by the Engineer, are found then the entire area affected shall be decontaminated.
- C. Remove equipment, materials, and debris from the work site.
- D. Dispose of asbestos-containing waste material as specified in Part 3.7 of this Section.

3.09 SCHEDULE OF REMOVALS

- A. Conduct asbestos abatement work as specified in accordance with Project Phasing Requirements.

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 02090

LEAD BASED PAINT REMOVAL AND OFF-SITE MANAGEMENT

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section specifies requirements for working with existing materials that have been painted with lead-based paint. Contractor is responsible for compliance with all regulations, as well as specific requirements of this Section, pertaining to the handling and disposal of materials that contain or are contaminated by lead. A licensed deleading contractor does not have to conduct work where LBP is impacted. Rather, the requirements of this Section are intended to ensure that personnel who disturb LBP are properly trained and qualified; use appropriate personal protection; use methods that do not create lead dust, chips, or fume; and properly dispose of generated materials as a hazardous lead waste.
- B. At all times, Contractor shall utilize methods that minimize the generation of airborne lead particulate and fume and the dispersal of paint chips, soil, or other material that are covered or contaminated by lead. Contractor shall provide engineering controls and dust control measures, as necessary, to prevent the migration of lead particulate and fume to adjacent areas. Where workers will be exposed to lead, Contractor shall provide all appropriate personal protective equipment as specified herein, by OSHA, and applicable state and local regulations.
- C. Related Work Specified in Other Sections:
 - 1. Section 02050 – Demolition

1.02 SUBMITTALS

- A. Work Plan: Submit a site specific OSHA written compliance plan before conducting any work that impacts LBP. Plan must include worker orientation plan that at a minimum includes a description of lead hazards and abatement methodologies, a review of worker protection requirements, and the outline of safety procedures.
- B. Permits for transport and disposal of debris. Also, submit copies of manifests and receipts acknowledging disposal of all hazardous and non-hazardous waste material from the project showing delivery date, quantity, and appropriate signature of landfill's authorized representative
- C. For all work that may cause employee exposure to lead above the OSHA Action Level, provide the following documentation for employees:

1. Copies of medical records, including lead blood level monitoring data and a notarized statement by the examining medical doctor that such examinations took place, and when, for employees to be used on the project.
2. Record of successful respirator fit testing performed by a qualified individual within the previous six months, for each employee to be used on this project with the employee's name and social security number with each record;
3. Proposed respiratory protection program for employees throughout all phases of the job, including make, model and NIOSH approval numbers of respirators to be used; if applicable.
4. If exposure monitoring or historic data has determined that employees will not be exposed to lead above the OSHA action level, the above requirements are not necessary. If personal samples are collected, submit results to Owner's representative in a timely manner.

1.03 QUALITY ASSURANCE

- A. Coordinate work which may disturb surfaces coated with lead-based paint among the trades and with the Owner, so that Work is performed in the proper sequence to minimize disturbance of lead-based paint and to protect other trades
- B. The Contractor shall be responsible for the following precautions:
 1. Take care to prevent unqualified personnel from disturbing the existing lead-based paint.
 2. The Contractor shall be responsible for apprising all other workers, supervisory personnel, subcontractors and consultants who will be at the job site of the hazard and of proper procedures, and shall be responsible for enforcing proper procedures.

1.04 EXISTING CONDITIONS

- A. Lead is present in paints at the site in varying contents. The highest concentrations (i.e. 1.0 mg/cm² or greater) are present on the following:

Results of Testing for Lead-Based Paint Worcester Road Wastewater Pumping Station				
Location	Substrate	Color	Component	Approx. Quantity
Main Exit	Metal	Green	Railing	1 each
Interior Stairs	Metal	Gray	Stairs	1 each

B. THE CONDITION OF LOCATIONS AND SUBSTRATES NOT SPECIFICALLY NAMED ABOVE IS UNKNOWN.

1.05 APPLICABLE REGULATIONS

A. The following may be applicable State and Federal regulations for the project:

1. Occupational Safety and Health Administration
 - a. 29 CFR 1910: General Industry Standards
 - b. 29 CFR 1910.1025: Lead Standard for General Industry
 - c. 29 CFR 1910.134: Respiratory Protection
 - d. 29 CFR 1910.1200: Hazard Communication
 - e. 29 CFR 1926: Construction Industry Standards
 - f. 29 CFR 1926.62: Construction Industry Lead Standard
2. Commonwealth of Massachusetts
 - a. 454 CMR 22.00, Massachusetts Department of Safety
 - b. 310 CMR Parts 19 and 30, Massachusetts Department of Environmental Protection.

- B. All regulations by the above and other governing agencies in their most current version are applicable throughout this project. Where there is a conflict between this Specification and the cited federal, state or local regulations or guidelines, the more restrictive or stringent requirements shall prevail. This Section refers to many requirements found in these references, but in no way is it intended to cite or reiterate all provisions therein or elsewhere. It is the contractor's responsibility to know, understand, and abide by all such regulations, guidelines and common practices.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Fire rated polyethylene sheet in a roll size to minimize the frequency of joints shall be delivered to job site with factory label indicating 6 mil.
- B. Polyethylene disposable bags shall be six (6) mil with pre-printed label.
- C. Tape or adhesive spray will be capable of sealing joints in adjacent polyethylene sheets and for attachment of polyethylene sheet to finished or unfinished surfaces of dissimilar materials and capable of adhering under both dry and wet condition, including use of amended water.
- D. Impermeable containers are to be used to receive and retain any lead containing or contaminated materials until disposal at an acceptable disposal site. The containers shall be labeled in accordance with EPA and DOT standards.

- E. Machine Sanding Equipment - Sanders shall be of the dual action, rotary action, orbital or straight line system type, fitted with a high efficiency particulate air (HEPA) dust pick-up system.

2.02 TOOLS AND EQUIPMENT

- A. Provide suitable tools for all operations related to LBP.
- B. The Contractor shall have available sufficient inventory or dated purchase orders for materials necessary for the job including protective clothing, respirators, filter cartridges, 6-mil fire-rated polyethylene sheeting of proper size, tape, and air filters.
- C. The Contractor shall have available power cables or sources such as generators (where required).

PART 3 - EXECUTION

3.01 WORK AREA PREPARATION

- A. Prior to the commencement of any work that may cause employees to be exposed to an airborne concentration of lead **above the PEL**, the following work area preparation shall be required:

1. Signs warning of the potential exposure to lead shall be posted. The signs shall have the following designation:

**WARNING:
LEAD WORK AREA
POISON
NO SMOKING OR EATING**

2. Decontamination Area. At a minimum, the Contractor shall construct a change area with attached shower (hand-washing facilities may be used in lieu of showers during the period that the contractor is conducting initial monitoring to determine worker exposure to airborne lead). This decontamination area shall be directly adjacent to the work area for the decontamination of workers contaminated with lead. The contractor shall ensure that employees use the worker decontamination area prior to leaving the work area. The decontamination area shall be constructed with six-mil polyethylene sheeting on floors, walls and ceiling.
 3. The work area boundary shall be defined by caution tape supplemented by appropriate warning signs. For **interior** work areas, all openings to the work area shall be covered with two layers of 6-mil polyethylene and sealed with duct tape. A decontamination unit, consisting of change area and shower, shall be installed at the entrance to the work area.
- B. The Contractor shall maintain tarps/polyethylene barriers, and a clean area as long as needed for the safe and proper completion of the work. Any openings or tears in

the work area barriers shall be corrected by the Contractor at the beginning of each work day. Work will not be allowed to commence until all barriers are in place and acceptable to the consultant.

3.02 PERSONAL AIR MONITORING

- A. General: The contractor is required to perform personal air monitoring in accordance with OSHA standards during all work involving a potential exposure to airborne lead. The results of such sampling shall be posted, provided to individual workers, and submitted to Owner and consultant as described herein.
 - 1. In lieu of monitoring, Contractor may use historical data from previous projects in accordance with the criteria outlined in 29 CFR Part 1926.62 (d).
- B. Sampling: Samples shall be taken for the duration of the work shift or for eight hours, whichever is less. Personal samples need not be taken every day after the first day if working conditions remain unchanged, but must be taken every time there is a change in the removal operation, either in terms of the location or the type of work. Sampling will be used to determine eight-hour Time-weighted Averages (TWA). The Contractor is responsible for personal sampling as outlined in OSHA Standard 29 CFR 1926.62. This sampling will determine the degree of respirator protection required, subject to the regulations.
- C. Sampling Results: Air sampling results shall be transmitted to the Owner and individual workers in written form no more than forty-eight (48) hours after the completion of a sampling cycle. The reporting document shall list each sample's result, sampling time and date, personnel monitored and their social security numbers, flow rate, sample duration, sample yield, cassette size, and analysts' name and company, and shall include an interpretation of the results. Air sample analysis results shall be reported in micrograms of lead per cubic meter of air (μ/m^3).
- D. Air Monitoring Frequency. The air monitoring frequency for Contractor operations will be established in accordance with the requirements set forth in 29 CFR 1926.62

3.03 WORKER PROTECTION REQUIREMENTS

- A. Biological Monitoring: The contractor shall be responsible for medical surveillance and record keeping, as defined in the OSHA Lead in Construction Standard (29 CFR 1926.62) and Local Law. In addition, contractor shall have a medical examination performed on each employee if exposure is above the OSHA Action Level. This medical examination must be performed before workers begin lead contaminated work area and at the termination of an employee's employment or yearly, whichever comes first.
- B. Training Requirements: All workers shall be trained about the exposures to lead hazards at a minimum to the requirements of OSHA regulation 29 CFR 1926.62. The contractor shall provide copies of training certificates.
- C. Respirators and Personal Protective Equipment (PPE):

1. Personal protection in the form of disposable coveralls and NIOSH and MSHA approved respirators, is required for all workers, supervisors, and authorized visitors entering the work area during operations that generate airborne lead.
2. Provide a clean area for workers to put on suits and other personal protective equipment and to store their street clothes.. In addition to disposable suits for the workers, the Contractor shall also supply suits for the Consultant and other personnel who are authorized to inspect the work site. Contractor must consider this cost in the bid. Disposable suits, such as TYVEK suits, and other personal protective equipment (PPE) must be donned prior to entering work area. Light weight nylon clothes may be worn under the suit, but these clothes must be changed before leaving the work area and should be laundered separately.
3. Supply workers and supervisory personnel with NIOSH and MSHA approved respirators and HEPA filters. Respiratory protection shall be implemented for all work performed by the Contractor under this Section. The respirators shall be sanitized and maintained according to the manufacturer's specifications. Disposable respirators shall not be considered acceptable under any circumstances. The Contractor shall maintain on-site a sufficient supply of HEPA filters to allow workers and supervisory personnel to change contaminated filters per manufacturer's recommendations or when breathing resistance is encountered. The Contractor is solely responsible for means and methods used and for compliance with applicable regulations:
4. Respirators shall be individually assigned to workers for their exclusive use. All respiratory protection shall be provided to workers in accordance with the approved respiratory protection program, which includes all items in OSHA 29 CFR 1910.134 (B), (D), (E) & (F).

3.04 REMOVAL OF LOOSE PAINT AND PAINT CHIPS

- A. The Contractor shall remove all loose paint chips from all known LBP surfaces. Contractor shall utilize power wash and HEPA vacuums to clean all loose LBP from walls, columns, beams, mechanical equipment, floors, windows, doors, etc. All loose paint chips shall be properly packaged for disposal as a hazardous lead waste.
- B. Contractor is responsible for all demolition activities required to access and remove doors and windows, such as masonry, plaster, wood, etc.

3.05 DISPOSAL OF WASTE MATERIAL

- A. All materials, whether hazardous or non-hazardous, shall be disposed of in accordance with all laws and the provisions of this Section and any or all applicable federal, state, county, or local regulations and guidelines. It shall be the sole responsibility of the Contractor to assure compliance with all laws and regulations relating to this disposal. The requirements of the Resource Conservation and Recovery Act (RCRA) must be

complied with, as well as any or all other applicable federal, state, county, or local waste requirements.

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 02095

PCB REMOVAL AND RELATED WORK

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

- A. Building materials coated with paint containing polychlorinated biphenyls (PCBs) have been identified at the Worcester Road Sewer Pump Station, 730 Worcester Road in Framingham, MA. Building material testing results and locations of confirmed PCB-containing materials are described in the Risk-Based PCB Bulk Product Waste Disposal Plan, dated May 2022, and prepared by BETA Group, Inc. A copy of this report is included in Appendix 7.
- B. The Contractor shall be aware of all conditions of the Project and is responsible for verifying quantities and locations of all Work to be performed. Failure to do so shall not relieve the Contractor of its obligations to furnish all labor and materials necessary to perform the Work.
- C. The Contractor, or remediation Subcontractor, is responsible for conducting all Work as part of the PCB Remediation portion of the Worcester Road Sewer Pump Station in accordance with this specification, with all referenced documents included as part of this specification, with the standards and guidance documents listed below, and with all Federal, state, and local regulations.

1.2 DESCRIPTION OF WORK

- A. It is the intent of the Work described in this section to segregate and remediate any known or assumed PCB-containing materials that are scheduled to be removed or encapsulated in place as part of the overall Worcester Road Sewer Pump Station Rehabilitation Project. As described in 40 CFR Part 761, the continued use of paints containing PCBs at concentrations greater than 50 parts per million (ppm) is prohibited. If materials containing greater than or equal to 50 ppm PCBs are generated as waste, they would be defined as PCB Bulk Product Waste and would require disposal per 40 CFR 761.62. These materials within the project work areas include paint covering interior metal piping and equipment, appurtenances, concrete masonry units (CMUs), and concrete floors and walls of the existing pump station building.
- B. The Contractor shall prevent the contamination of the air, soil, and water around the project site during PCB removal. All PCB work is to be performed in accordance with these specifications, and the relevant requirements of the following organizations: Environmental Protection Agency (EPA), Occupational Safety and Health Administration (OSHA), Department of Transportation (DOT), National Institute of Occupational Safety and Health (NIOSH), Massachusetts Department of Environmental Protection (DEP), Massachusetts Department of Labor and Industries (DLI), and all other state and local regulations. Wherever there is a conflict or overlap of the above references, the most stringent provisions apply.
- C. The work of this Section consists of, but is not limited to:

1. Furnishing of all labor, materials, facilities, equipment, services, and insurance necessary to perform the work;
 2. Maintenance of work area/site security;
 3. Preparation of work area, including installation of containment and decontamination areas as required;
 4. Removal, segregation, and/or containment of any PCB-containing materials encountered during the project work;
 5. Clean-up and final decontamination of all work areas;
 6. Implementation of a worker protection program in compliance with all applicable regulations;
 7. Proper storage, wrapping/bagging, labeling, transportation, and disposal of all waste generated as part of PCB remediation activities.
- D. The Contractor shall utilize all means possible to prevent PCB-containing materials from migrating out of the work area(s). This shall include, at a minimum, ground cover or staging/lift covers consisting of fire retardant polyethylene sheeting or equivalent, engineering controls to minimize dust (i.e., wetting the material prior to cutting).
- E. The Contractor, or remediation Sub-contractor, will clean all work areas at the end of each workday and will collect and store all PCB-containing waste as specified in Part 3 of this section.

1.3 RELATED WORK

- A. Section 02080 – SOIL AND WASTE MANAGEMENT
- B. Section 02082 – ASBESTOS ABATEMENT AND RELATED WORK

1.4 PERMITS AND APPLICABLE STANDARDS

- A. The Contractor, or remediation Sub-contractor, must maintain current licenses or registrations pursuant to EPA and DEP regulations for all Work related to this Project, including the removal, handling, transport, and disposal of hazardous and industrial waste.
- B. The Contractor shall perform all work in accordance with these specifications, the USEPA and OSHA regulations, the conditions of the USEPA Approval of the *Risk-Based PCB Bulk Product Waste Disposal Plan*, NIOSH recommendations, MassDEP and MassDOT regulations, local statutes, local ordinances, local codes and any other applicable federal, state, and local government regulations and guidelines.\
- C. The Contractor shall obtain all permits required to complete the work, including but not limited to utility work permits, discharge permits, or any other permits required by local government regulations as applicable.

1.5 REFERENCES

Perform Work in accordance with all applicable regulations, including but not limited to the publications listed below, which form a part of this specification to the extent referenced. The publications are referenced in text by basic designation only. The list provided below is not intended to be all inclusive of each regulation prevailing over the work. The latest version of the document listed shall govern the work performed. Where more stringent requirements are specified, adhere to the more stringent requirements.

A. Environmental Protection Agency

1. Polychlorinated Biphenyls (PCBs), Environmental Protection Agency, Toxic Substance Control Act, 40 CFR 761.
2. Solid Wastes, Title 40, Subchapter 1, 40 CFR 240-299.

B. Occupational Safety and Health Administration (OSHA)

1. Respiratory Protection, 29 CFR 1910.134.
2. Specification for Accident Prevention Signs and Tags, 29 CFR 1910.145.
3. Hazard Communication, 29 CFR 1910.1200.
4. Construction Industry, 29 CFR 1926.

C. U.S. Department of Transportation (USDOT)

1. Transportation Standard, 49 CFR 171-173.

D. Massachusetts Department of Environmental Protection

1. Hazardous Waste Regulations, 310 CMR 30.000.
2. Massachusetts Contingency Plan, 310 CMR 40.000.
3. Massachusetts Solid Waste Management Regulations, 310 CMR 19.000.

E. American National Standard Institute (ANSI)

1. Practices for Respiratory Protection, Z88.2-80.
2. Fundamentals Governing the Design and Operation of Local Exhaust Systems, Z9.2-79.

F. City of Framingham, Board of Health

1.6 DEFINITIONS

G. All terms not defined herein shall have the meaning given in the applicable publications and regulations.

A. PCB Remediation: Procedures to control releases from PCB-containing materials. Includes encapsulation, enclosure, and removal.

B. Air Monitoring: The process of measuring contaminant content of a specific volume of air in a stated period of time.

- C. ANSI: American National Safety Institute
- D. Remediation Contractor: Contractor responsible for conducting the work associated with the removal, handling, packaging, transportation and disposal of PCB waste materials.
- E. Authorized Visitors: Any visitor authorized by the Owner, the Engineer or any representative of a regulatory agency or other agency having jurisdiction over the project.
- F. Barrier: Any surface that seals off the work area to inhibit the movement of contaminated media.
- G. Contractor: Refers to the General Contractor and/or Subcontractor responsible for the Work under contract with Project Manager.
- H. Critical Barrier: An impermeable partition erected to constitute a work area closure.
- I. Encapsulation: All herein specified procedures necessary to coat and seal surfaces containing residual PCB-containing materials to control the possible release of contaminated media into the ambient air.
- J. Enclosure: All herein specified procedures necessary to conduct abatement of PCBs behind an airtight impermeable permanent barrier to prevent the release of contaminated media into the ambient air.
- K. HEPA Filter: Equipment with a High Efficiency Particulate Air (HEPA) filter, greater than 99.97 percent efficiency by 0.3-micron DOP test and complying with ANSI Z9.2 (1979).
- L. Mass DEP: Massachusetts Department of Environmental Protection.
- M. Mass DOS: Massachusetts Department of Occupational Safety.
- N. SDS: Safety Data Sheet
- O. MSHA: Mine Safety and Health Administration
- P. NESHAP: National Emission Standards for Hazardous Air Pollutants
- Q. NIOSH: National Institute of Occupational Safety and Health
- R. OSHA: Occupational, Safety and Health Administration.
- S. PCB: Polychlorinated Biphenyls
- T. PCB Bulk Product Waste: Materials as defined by the USEPA Memorandum regarding PCB Bulk Product Waste Reinterpretation date October 24, 2012
- U. PCB Wastes: Building materials and debris, soil, disposable clothing and protective equipment, plastic sheeting and tape, exhaust systems or vacuum filters, or any remediation equipment that is or has been contaminated with PCBs and cannot be completely cleaned by vacuuming or by washing.

- V. Removal: All herein specified procedures necessary to strip all PCBs from designated areas and to dispose of these materials at a permitted facility.
- W. Respirator: A device designed to protect the wearer from the inhalation of harmful atmospheres.
- X. Subcontractor: Any contractor working for the General Contractor.

1.7 TRAINING

- A. The Contractor, or remediation Sub-contractor, is responsible for ensuring that all remediation worker personnel shall receive appropriate training and information regarding the potential hazards of PCBs, safety and health precautions, and the use and requirements of protective clothing and equipment prior to the start of any remediation work.
- B. B. The Contractor is responsible for establishing a respirator program as required by ANSI Z88.2 and 29 CFR 1910.134. The Contractor shall provide respirator training and fit testing, and medical surveillance for those workers conducting removal or remediation activities that require the use of a respirator.

1.8 SUBMITTALS

- A. The Contractor shall submit to the Owner the following listed items within 10 days after notice to proceed. No PCB removal work activities shall commence until these items are reviewed by the Owner and/or their designated Engineer, unless otherwise waived. Submittal data shall be in sufficient detail to enable the Engineer to evaluate the Contractor's proposed work plans, methodologies, products and equipment for the purposes of determining conformity with the Project Specifications.
 - 1. PCB Removal Work Plan, clearly indicating the following:
 - a. All work areas / containments;
 - b. Locations and types of all decontamination enclosures;
 - c. A description of the procedures to be used to contain, treat, and dispose of cleaning media. Use of pressure washing to clean PCB impacted surfaces is prohibited.;
 - d. Description of air monitoring locations, equipment, and procedures;
 - e. A description of the proposed packaging procedures;
 - f. Entrances and exits to the work areas;
 - g. Type of remediation activity / technique for each work area / containment;
 - h. Sequence of work activities;
 - i. Proposed location and construction of storage facilities and field office;
 - j. Location of utility connections to building services;
 - k. Waste storage locations;
 - l. Waste transport routes to the waste storage containers;
 - m. Products, equipment, and materials to be used on the project, including specifications and Material Safety Data Sheets for all products used on the project;

The Contractor's PCB Removal Work Plan may require submittal to EPA as part of the Agency's approval of this work. The Owner's Engineer must review all documents prior to submittal to EPA.

2. A list of similar projects performed by the Contractor within the past two (2) years. The name, address, phone number and contact person shall be provided for each project reference.
3. Site-specific Health & Safety Plan (HASP), indicating the means and methods by which the Contractor will follow applicable Federal and State regulations regarding the work activities, including but not limited to OSHA regulations, fall protection standards, respiratory protection, ladder/scaffolding safety, personal protective equipment, etc.
4. Handling and management procedures for disposable protective clothing to be used on this Project.
5. Treatment, Storage or Disposal Facility permits from applicable regulatory agency.
6. Waste transporter permits and other transportation documentation.
7. Certification of compliance with OSHA requirements including but not limited to medical surveillance, record keeping and personal monitoring. Documentation of worker training, respiratory protection, and medical examination.
8. The Contractor shall provide the originals of all waste disposal manifests, disposal logs, and Certifications of Disposal within 30 days of waste shipment.
9. The Contractor shall provide within 30 days of project completion all daily progress log, including the entry/exit log.

1.9 PROJECT SUPERVISOR

- A. The Contractor shall designate a Project Supervisor who shall meet the following qualifications:
 1. The Project Supervisor shall be trained in PCB removal and hazardous waste management via an OSHA 40-hour HAZWOPER training and OSHA 8-hour Supervisor training.
 2. The Project Supervisor shall have a minimum of one year experience as a supervisor.
- B. The Project Supervisor must be on-site at all times during the execution of the Work of this section. The Project Supervisor shall be responsible for the performance of the Work of this section and shall be the primary point of contact for the Owner.
- C. The Site Safety Officer with the above-listed training can fulfill this role.

1.10 AUTHORITY TO STOP WORK

- A. The City of Framingham (the Owner) has the authority to stop the work at any time it determines either personally or through the services of the Owner's Engineer that conditions are not within the specifications and applicable regulations. The stoppage of work shall continue until conditions have been corrected and corrective steps have been taken to the satisfaction of the Owner's Engineer. Standby time required to resolve violations shall be at the Contractor's expense, and any fines, etc., for hazardous conditions or non-compliance will be at the Contractor's expense and will not be grounds for change orders or time extension.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. The Contractor shall deliver all materials and equipment to the site in the original containers bearing the name of the manufacturer, and details for proper storage and usage.
- B. All materials or equipment delivered to the site shall be unloaded, temporarily stored, and transferred to the work area in a manner, which shall not interfere with building operations.
- C. Unloading procedures, temporary storage sites, and transfer routes, must be reviewed in advance by the Engineer.
- D. Damaged or deteriorated materials may not be used and must be promptly removed from the premises. Material, which becomes contaminated with PCBs, shall be packaged and legally disposed of in an approved, secure landfill.
- E. All materials, tools and equipment must comply, at a minimum, with this specification, and relevant Federal, State and local codes.

2.2 MATERIALS, TOOLS AND EQUIPMENT

- A. All plastic sheeting (“poly”) and bags used on the Project (including but not limited to sheeting used for barriers, fixed objects, walls, floors, ceilings, and waste containers) shall be polyethylene or equivalent with a thickness of at least 6 mil for all applications.
- B. Tools used for the removal of caulking or other PCB materials shall be used in a manner that minimizes dust generation, as appropriate. Tools used to apply coatings shall be as recommended by the manufacturer.
- C. All dry vacuuming performed under this contract shall be performed with High Efficiency Particulate Absolute (HEPA) filter equipped industrial vacuums conforming to ANSI Z9.2.
- D. Any power tools used to drill, cut into, or otherwise disturb PCB material shall be manufacturer equipped with HEPA filtered local exhaust ventilation.

2.3 SAFETY SUPPLIES AND PROTECTIVE CLOTHING

- A. All personnel must utilize proper PPE during all work activities. Proper PPE may vary depending on the job task, but may include disposable gloves, disposable rubber boots, steel-toe boots, Tyvek suits, protective vests, respirators, including replacement cartridges, hard hats, hearing protection, and eye protection.
- B. Respiratory Protection
 - 1. The Contractor shall provide all workers with a full or half face piece respirator which is approved by NIOSH/MSHA for protection against PCBs and dust and which meets the requirements of the OSHA Standard under 29 CFR 1910.134.

2. Respirators shall be individually fit-tested to personnel under the direction of an Industrial Hygienist on a yearly basis. Fit-tested respirators shall be permanently marked to identify the individual fitted, and use shall be limited to that individual. The Contractor shall maintain fit-test records for each employee using a respirator.
 3. No respirators shall be issued to personnel without such personnel participating in a respirator training program.
 4. The Contractor shall provide a storage area where respirators will be kept in a clean environment.
 5. The Contractor shall provide and make available a sufficient quantity of respirator filters so that filter changes can be made as necessary during the workday. Filters will be removed and discarded during the decontamination process at a frequency at least as often as recommended by the manufacturer's specifications. Filters cannot be reused. High Efficiency Particulate Air (HEPA) respirator filters shall be approved by NIOSH and shall conform to the OSHA requirements in 29 CFR 1910.134.
 6. Filters used with negative pressure air purifying respirators shall not be used any longer than one eight (8) hour workday.
- C. The Contractor shall provide sufficient quantities of protective clothing to assure a minimum of four (4) complete disposable outfits per day for each individual performing remediation Work.
- D. Eye protection and hard hats shall be provided and made available for all personnel entering any Work Area.
- E. Authorized visitors shall be provided with suitable protective clothing, headgear, eye protection, and footwear whenever they enter the Work Area. Authorized visitors will not enter a Work Area where respiratory protection is required unless the visitor has been approved and individually fit-tested for respirator use.

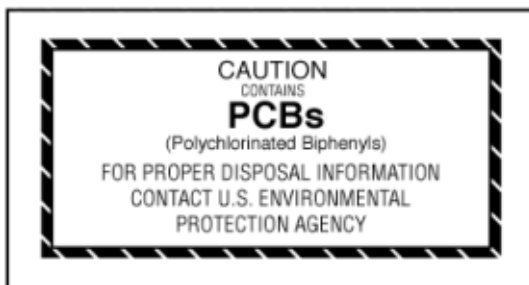
2.3 SIGNS, LABELS, AND CONTAINERS

- A. Provide warning signs and barrier tapes at all approaches to the PCB-designated Work Areas. Locate signs at such distance that personnel may read the sign and take the necessary protective steps required before entering the area. If necessary, signs should be legible in the language(s) of the workers.
- B. Provide the appropriate "Large PCB Marking" or "Small PCB Marking" (ML or MS per 40 CFR 761) as shown below, of sufficient size to be clearly legible, for display on waste containers (bags, boxes, rolloffs or drums) which will be used to contain or transport PCB contaminated material, in accordance with 40 CFR 761. In addition, U.S. Department of Transportation (DOT) 49 CFR Parts 171 and 172 requires the name and UN number of the material to be on the bags or drums, and, if shipped in bulk (rolloffs, Gaylord boxes, etc) the bulk container must also be labeled: Polychlorinated biphenyl, solid mixture UN 3432, if designated as hazardous waste.



ML

MS



- C. Some PCB materials may also be Hazardous Waste and must have a label stating the following on each container:

HAZARDOUS WASTE--Federal Law Prohibits Improper Disposal. If found, contact the nearest police or public safety authority, or the U.S. Environmental Protection Agency.

Generator's Name and Address:

Generator's EPA Identification Number:

Manifest Tracking Number:

- D. Provide 6 mil polyethylene disposal bags with PCB caution labels.
1. The "Small PCB Label" (MS per 40 CFR 761) may be used as shown above. Bags shall also be labeled with U.S. DOT required markings per 49 CFR 172, Polychlorinated biphenyl, solid mixture UN 3432.
 2. Labeled PCB waste containers or bags shall not be used for non-PCB waste or trash. Any material placed in labeled containers or bags, whether turned inside out or not shall be handled and disposed of as PCB waste.

- E. A secure, lined, and covered waste container (roll-off or equivalent), 55-gallon DOT-approved steel containers, or equivalent will be staged for the collection of PCB wastes generated during the work activities in accordance with 40 CFR 761.65.

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

- A. The work of this section consists of, but is not limited to:
 - 1. Furnishing of all labor, materials, facilities, equipment, services, and insurance necessary to perform the work;
 - 2. Maintenance of work area/site security;
 - 3. Preparation of work area, including installation of containment and decontamination areas as required;
 - 4. Removal, segregation, and/or containment of PCB-containing materials;
 - 5. Clean-up and final decontamination of all work areas;
 - 6. Implementation of a worker protection program in compliance with all applicable regulations;
 - 7. Proper storage, wrapping/bagging, labeling, transportation and disposal of all waste generated as part of PCB remediation activities.
- B. All remediation activities are to be conducted in accordance with the May 2022 *Risk-Based PCB Bulk Product Waste Disposal Plan* and the conditions of the EPA's Approval.
- C. The Contractor shall provide a description of the means and methods, which will adhere to these specifications, of all aspects of the remediation activities to the Owner prior to commencing remedial activities, which will be subject to Owner review and approval.
- D. The Contractor shall develop a Site-Specific Health & Safety Plan (HASP) for their workers and specific to the work activities.
- E. The Contractor is responsible for immediately reporting any breach in containment, health and safety incidents, and/or any on-site visits by a regulatory agency to the Owner.
- F. The following documentation shall be maintained on-site by the Contractor during remediation activities:
 - 1. Medical approval, fit test reports, Worker Acknowledgments, and Training certificates;
 - 2. Project documents (Risk-Based PCB Bulk Product Disposal Plan, contractor work plan, drawings, specifications, etc.);
 - 3. Material Safety Data Sheets;
 - 4. List of Emergency Contact Information;

5. Project logs (as applicable).

3.2 WORK AREA PREPARATION

- A. Access to the active work areas will be controlled through the use of controlled access points, fire retardant polyethylene containments, and/or signage.
- B. Polyethylene containments will be constructed to enclose each work area prior to conducting remediation work in that work area. All polyethylene (plastic) sheeting used on the Project shall be at least 6-mil fire retardant sheeting.
- C. All movable objects shall be removed from the work area prior to conducting work. All non-movable objects shall be covered with 6-mil fire retardant polyethylene sheeting and sealed at the edges.
- D. All work areas and work area perimeters will be kept free from debris and maintained in a safe condition. At the end of each workday, the work areas will be inspected and all dust and debris cleaned and placed in appropriate disposal containers.

3.3 REMOVAL OF PCB CONTAINING BUILDING MATERIALS

- A. This work includes the removal and off-site disposal of the following PCB-containing materials in accordance with the Worcester Road Sewer Pump Station Risk-Based PCB Bulk Product Disposal Plan: painted interior metal piping and equipment, painted concrete masonry units (CMUs), concrete powder generated during installation of new piping and utilities, and paint on concrete foundation walls and floors of the existing pump station building.
- B. PCB-containing materials subject to removal and off-site disposal shall be removed through a combination of mechanical and physical means. Proper removal techniques and engineering controls shall be utilized to minimize the generation and spread of dust and debris throughout the work area:
 - 1. The upper portion of the existing pump station will be demolished and PCB-containing building materials will be stockpiled temporarily for removal and disposal as PCB Bulk Product Waste. The demolition of the pump station will be advanced in a way that preserves the underlying foundation, and the new building will be constructed on and within the footprint of the existing foundation.
 - 2. Equipment and building materials to be removed and which are coated with paint presumed or confirmed to contain concentrations of PCBs greater than 50 ppm will be managed as PCB Bulk Product Waste. The remaining surfaces coated with paint assumed or confirmed to contain PCB concentrations greater than 50 ppm shall be sandblasted to remove all visible paint and encapsulated with an epoxy coating to prevent the release of residual PCBs from the remaining substrates.
 - 3. All powered tools will be manufacturer equipped with appropriate tool guards and dust/debris collection systems (i.e., HEPA filters). Wet wiping and vacuuming of all tools and equipment in the work area will be performed at the completion of the work activity.

4. All dry vacuuming performed under this contract shall be performed with High Efficiency Particulate Absolute (HEPA) filter equipped industrial vacuums conforming to ANSI Z9.2.
- C. Air monitoring within the support work zone and perimeter to this zone will be conducted during the active removal of concrete. To reduce dust levels and exposures to dust, a combination of engineered controls (e.g., wetting, work zone enclosures), equipment equipped with HEPA filters and dust controls, and personal protective equipment (PPE – respirators) will be implemented as part of the work activities. Air monitoring will be conducted in accordance with the EPA approved Risk-Based PCB Bulk Product Waste Removal Plan.
- D. PCB containing materials shall be transported in appropriate containers (polyethylene bags, drums, etc.) from the Work Area along a designated route to the proper waste disposal containers.

3.4 APPLICATION OF ENCAPSULANT COATING

- A. Surfaces subject to encapsulation shall be prepared as described in the Risk-Based PCB Bulk Product Waste Removal Plan and as recommended by the product specifications. Estimated Area = XXXXX ft².
- B. The encapsulation of building materials shall be conducted using the following coatings: Sikagard 62, Sikagard 670W, Sikadur 35, BASF Sonoguard, or approved equivalents.
- C. The application of each encapsulating product is to be conducted in accordance with the manufacturer's specifications.

3.5 INSPECTION AND VERIFICATION

- A. At the end of each workday, the Contractor is responsible for inspecting and verifying the work areas are clean and free from dust and debris and secured to prevent unauthorized access.
- B. Following removal of PCB containing materials and encapsulant application, inspection and verification testing will be performed by Owner's consultant to verify completion of the EPA approved remediation activities.
- C. The Contractor is responsible for inspection of all waste storage containers and waste transport routes to verify proper waste handling, storage, and labeling in accordance with all applicable federal and state regulations.
- D. Prior to removal of the containment structures, the Contractor is responsible for verifying all remedial actions have been completed in accordance with the Risk-Based PCB Bulk Product Waste Removal Plan.
- E. To verify task completion, sample collection and analytical testing may require up to a 10 business day turnaround time prior to receiving verification results. Appropriate project planning and scheduling should be incorporated into the overall project plans.

3.6 EQUIPMENT AND WORK AREA DECONTAMINATION

- A. The Contractor, or remediation Subcontractor, will clean all work areas at the end of each workday and will collect and store all waste generated from the remediation process (e.g., removed PCB containing material, dust from HEPA filters, etc.) in secure, closed containers that are properly labeled.
- B. When remediation of PCB materials is completed via verification inspections and/or sampling, the decontamination process shall consist of vacuuming (with a HEPA filter), wet wiping/mopping and a repeated vacuuming (with a HEPA filter) of the entire interior work area. All surfaces in and around the work area must be free of dust generated during the work. Final cleaning shall be performed only after all PCB-waste is packaged and removed, but before reinstalling or demolishing any equipment, or dismantling any barrier, decontamination facilities, or protective coverings. Cleaning shall be subject to the approval of Owner's Engineer based on a visual inspection and air testing.
- C. Decontaminate all tools and equipment before removal from the work area in accordance with EPA guidelines.
- D. If dust or debris has migrated to areas of the building other than the immediate work area, those areas shall be incorporated into the work area and thoroughly decontaminated to ensure all visible dust generated by the activity is eliminated.
- E. Remove containment barriers and any other protective sheeting. Place in disposable construction bags (6-mil poly) and dispose of as PCB waste.
- F. Visually inspect the area for any remaining dust or debris. Vacuum (with HEPA filter) and wet wipe until space is clean.
- G. After completing decontamination and removing containment barriers, a final inspection shall be performed by the Contractor and Owner. If the visual inspection reveals that additional cleaning is needed, the Contractor will clean or re-clean the affected areas at no additional expense to the Owner.
- H. The Contractor, or remediation Subcontractor, shall not stockpile any PCB waste on-site that is not properly containerized and labeled in accordance with this Section.
- I. The Owner will designate a temporary 'hazardous waste storage' area for the storage of PCB waste. The location will be determined prior to the start of Work.

3.7 PCB WASTE DISPOSAL

- A. General Requirements - All PCB wastes must be handled, packaged, stored, transported, and disposed of as specified in this subsection, and in compliance with all federal, state and local regulations and codes. The Contractor, or the remediation subcontractor, is responsible for the disposal of all PCB waste and other solid waste debris generated at the Project. The Contractor shall give seventy-two (72) hour notification prior to removing any waste from the site. Waste shall be removed from the site only during normal working hours unless otherwise specified.

- B. Waste Labeling - All waste shall be labeled using the labels described in Section 2.3. If waste containers are not already so preprinted, warning labels having waterproof print and permanent adhesive shall be affixed to the lid and/or sides of the containers, whether or not these containers are further packaged. Warning labels shall be conspicuous and legible, and conform to the latest OSHA, EPA and DOT labeling requirements. The Contractor shall properly wrap/bag all waste from the remediation process (e.g., removed PCB-containing material, dust from HEPA filters, etc.) within the work area. Wrapped/bagged waste shall be stored in secure, closed containers (e.g., drums, roll-off containers) and labeled.
- C. Waste Packaging - The Contractor shall inspect each bag, drum or container to ensure that the package is secure. The secure drum/container shall then be placed in the designated temporary storage area.
- D. Waste Container Removal and Disposal Documentation
1. All waste generated as part of the PCB remediation work shall be removed from the Site within 30 calendar days after successful completion of all PCB remediation work.
 2. It is the responsibility of the Contractor to determine current waste handling, transportation, and disposal regulations for the work site and for each waste disposal landfill. The Contractor and its subcontractors must comply fully with these documents and all DOT and EPA requirements.
 3. The Contractor, transporter and landfill shall document generation, transport and disposal of the waste by use of the Hazardous Waste Manifest. This record is a legally required document, which identifies the generator, transporter(s), temporary storage location(s) and disposal site for any PCB-waste material. The waste management facility shall also provide the Owner with a copy of the Certificate of Disposal

END OF SECTION

SECTION 02100
SITE PREPARATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Requirements for removal of vegetation and topsoil at the site.

1.02 DEFINITIONS

A. Clearing: Removal of trash, vegetation, or organic matter alive or dead.

B. Grubbing: Removal of vegetation including stumps, buried logs and roots.

C. Scalping: Removal of grass turf to a depth of 3 inches.

D. Stripping: Removal of top soil after scalping operation is complete.

1.03 QUALITY ASSURANCE

A. Obtain Engineer's approval of staked work limits prior to starting the clearing, grubbing, and stripping.

1.04 PROJECT/SITE CONDITIONS

A. Environmental Requirements

1. Install erosion and sediment controls as necessary prior to starting the Work.

B. Existing Conditions

1. Temporarily remove property improvements, to the minimum extent necessary, to complete the work and restore improvements to condition which existed prior to construction.

PART 2 PRODUCTS

2.01 EXISTING PRODUCTS

A. Chips from cleared trees and brush.

PART 3 EXECUTION

3.01 PROTECTION

- A. Do not cut or injure any trees or other vegetation outside the limits of disturbance and/or permanent easement, as indicated on the drawings.
- B. Trees, shrubbery, or planting, along the traveled highways or roads, shall not be removed except with the written approval of the Engineer.
- C. Preserve certain vegetation such as trees, shrubs, hedges and plants within the construction area, as indicated on the drawings to be protected.
- D. Easement Clearing
 - 1. The Engineer shall designate trees to be removed within easement lines.
- E. Work In Improved Property
 - 1. Protect trees, cultivated hedges, lawns, shrubs, and plants that might be damaged by the Contractor's operations.
 - 2. Temporarily replant and care for trees less than 4 inches in diameter that would be damaged by the construction operation. After the construction operations have been substantially completed, replant in their original positions and care for until growth is reestablished. If trees, cultivated hedges, lawns, shrubs, and plants are injured to such a degree as to affect their growth or diminish their beauty or usefulness, they shall be replaced at the Contractor's expense by items of kind and quality existing at the start of the work.
 - 3. Do such handwork as may be required to prevent damage to buildings and improvements.
 - 4. Protect fences and stone walls and if needed to be removed to facilitate construction or if damaged, upon completion of the work, properly restore or repair to at least as good condition as existed prior to start of the work.

3.02 CLEARING

- A. Cut or remove all trees, saplings, brush, and vines, windfalls, logs, and trees lying on the ground, dead trees and stubs more than 1 foot high above the ground surface.
- B. Except where clearing is done by uprooting with machinery or where stumps are left longer to facilitate subsequent grubbing operations, trees, stumps, and the stubs to be cleared shall be cut as close to the ground surface as practicable, but no more than 6-inches above the ground surface in the case of small trees, and 12-inches in the case of larger trees. Saplings, brush, and vines shall be cut off close to the ground.

C. Selective Trimming

1. Cut back limbs and branches of trees to be preserved only to the extent necessary for construction.
2. Trim neatly, and cleanly so that the remaining tree will not be damaged and healing will be facilitated. Where limbs and branches over 1 inch in diameter have been cut, the newly cut area of the tree shall be given a thorough application of approved tree-healing paint.

D. Salvaged Wood

1. Logs, timber and other wood removed in the course of clearing found to be acceptable, as determined solely by the Engineer, shall remain the property of the applicable private property owner or the Owner, unless otherwise directed by the Engineer.
2. Cut logs, timber and other wood in 4 foot lengths and stack, as directed by the Engineer.
3. Prior to the final completion of the contract, all unclaimed logs, timber and other wood previously cut and stacked shall be removed from the site and properly disposed of by the Contractor at no additional cost to the Owner.

E. Chips from Cleared Wood and Brush

1. Stockpile for future use on cleared easements as indicated on the Drawings.
2. Spread at locations shown on the drawings once work is substantially complete.
3. If the wood chips from the cleared wood are not of sufficient amount, the Contractor at his own expense shall furnish the required amount to provide a minimum thickness as shown on the Contract Drawings.
4. Elm wood and elm bark shall not be used as chips for ground cover.

3.03 GRUBBING

- A. Remove completely all stumps.
- B. Remove to a depth of 12-inches all roots larger than 3-inches in diameter.
- C. Remove to a depth of 6-inches all roots larger than 1/2-inches in diameter.
- D. Measure depths from the existing ground surface or the proposed finished grade, whichever is the lower.

3.04 STRIPPING

- A. Strip topsoil, loam and unsuitable earth from the ground surface in areas cleared and grubbed.
- B. Utilize topsoil and loam, where possible, for finished surfacing.
- C. All loam to remain on site.
- D. Dispose of unsuitable materials off site at authorized disposal location.

3.05 DISPOSAL OF CLEARED AND GRUBBED MATERIALS

- A. Dispose of cleared and grubbed materials off site at authorized disposal location.
- B. Such disposal shall be carried on as promptly as possible after removal of material in the clearing and grubbing operations and shall not be left until the final period of cleaning up.
- C. Elm bark whether stripped from the wood or intact with the wood shall be either buried at least 1 ft. below grade in approved dumping areas or burned in a suitable incinerator off-site with satisfactory anti pollution and fire prevention controls to prevent the spread of Dutch Elm Disease.

END OF SECTION

SECTION 02140

DEWATERING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this section.
- B. Examine all Drawings and all other Sections of the Specifications for requirements therein affecting the work of this Section.

1.02 DESCRIPTION

- A. Dewatering consists of the removal of surface water and groundwater as necessary to perform the construction required by the contract in accordance with the drawings and specifications. Furnish all labor, materials, equipment, and incidentals required to:
 - 1. Design, furnish, operate, maintain, and remove temporary dewatering systems to control groundwater and surface water to maintain stable, undisturbed subgrades, and allow work to be performed under dry and stable conditions, and comply with all applicable permit and other regulatory requirements.
 - 2. Work to be done as part of dewatering includes, but is not limited to:
 - a. Work in areas where excavation to depth below the groundwater water level is required. This includes but is not limited to the installation of water main below existing drain lines, the installation of drainage piping and structures, and the installation of sewer structures and piping.
 - b. Lower hydrostatic pressure.
 - c. Prevent surface water from entering the excavation during construction.
 - d. Implement erosion and sedimentation control measures.
 - e. Provide system to treat/settle all water removed from excavations, except water that is re-infiltrated into the ground on site in a manner that does not result in negative on- or off-site impacts.
 - f. Provide an Environmental Site Professional/Dewatering Specialist/Field Representative (hereinafter referred to as the Dewatering Professional) who will be responsible for dewatering, reinfiltration, treatment and discharge of dewatering flows as specified and in compliance with all applicable permits and regulations.

3. Clean, uncontaminated groundwater or accumulated surface runoff removed from excavations shall be reinfiltreated to the ground if feasible, by means of a temporary infiltration trench or basin. The temporary infiltration trench or basin must be: 1) open to the surface or “open-air”; and 2) wider than it is deep. Otherwise, the Contractor must obtain an Underground Injection Control (UIC) permit from the Massachusetts Department of Environmental Protection (MassDEP) Bureau of Resource Protection (BRP) in accordance with 310 CMR 27.00.

Surface flow that could lead to offsite discharge is not permitted. If reinfiltration is not feasible, treated water shall be directly or indirectly discharged to a surface water in accordance with a National Pollutant Discharge Elimination System (NPDES) permit issued by the U.S. Environmental Protection Agency (EPA). If neither reinfiltration nor surface water discharge is feasible, treated water shall be discharged to the local sewer system in accordance with the appropriate permits and regulations or transported off-site to an approved facility. In no case shall dewatering flows be directly or indirectly released to surface waters or storm drains prior to settling and appropriate additional treatment. The Contractor is responsible for acquiring all the proper permitting required for the chosen method of discharge.

4. If work is expected to be conducted within soil or groundwater affected by oil or hazardous materials, or if the groundwater appears to be impacted, prior to any discharge, the groundwater or accumulated surface runoff shall be sampled and tested to meet the requirements of the NPDES Remediation General Permit (Appendix III), or other permit requirements if an alternative discharge/disposal method (e.g., discharge to sanitary sewer, off-site disposal) is selected by the Contractor. The Contractor is responsible for coordinating the selected method of permitting and discharge or disposal with the Owner’s Licensed Site Professional (LSP) to meet the applicable requirements of the Massachusetts Contingency at 310 CMR 40.00. Laboratory analysis of groundwater to be treated and discharged may include, but not be limited to, the following parameters:
 - a. RCRA 8 Metals, US EPA Methods 6010B and 6020;
 - b. Volatile Organic Compound (VOC), US EPA Method 8260B;
 - c. Semi Volatile Organic Compound (SVOC), US EPA Method 8270C;
 - d. Pesticides, US EPA Method 8081
 - e. Herbicides, US EPA Method 8151A
 - f. Corrosivity/Toxicity, US EPA Method 9040B and 9045C;
 - g. Reactivity, US EPA Method 7.3;
 - h. pH and
 - i. Ignitability, US EPA Method 1010

Upon sampling, testing and characterization of the groundwater or accumulated surface runoff, proper treatment or disposal of the impacted ground water or accumulated surface runoff shall be determined. Treatment, discharge or disposal

of impacted groundwater shall be in accordance with all applicable regulations and shall be approved by the Engineer and Owner prior to final discharge or disposal.

5. Related Sections:

- a. Section 02200 – Earth Excavation, Backfill, Fill, and Grading

1.03 SUBMITTALS

A. Shop Drawing: Submit the following in accordance with Article 6.17 of the General Conditions and Section 01300 – Submittals:

1. Qualifications of the both the Contractor's dewatering specialist or firm (design) and the Dewatering Professional (all other responsibilities) shall be submitted for approval a minimum of four (4) weeks prior to execution of any dewatering. The submittal shall include, but not be limited to:
 - a. Qualifications of firm's Registered Professional Engineer as specified in Section 1.04, B.
 - b. Qualifications of the Dewatering Professional who shall oversee the installation, operation and maintenance of the dewatering system.
2. Submit a Dewatering Plan including design calculations at least four (4) weeks prior to start of any dewatering operation. The submittal will be only for the information of the Owner and third parties for an overall understanding of the project relating to access, maintenance of existing facilities and proper utilization of the site. The Contractor shall remain responsible for the adequacy, regulatory compliance, and safety of the means, methods and sequencing of construction activities related to dewatering. The plan shall include the following items as a minimum:
 - a. Dewatering Plan and details stamped and signed by a Massachusetts Registered Professional Engineer that conforms to the requirements of the dewatering permit(s), the Wetlands Protection Act Order of Conditions, and all other applicable regulations and permits including, but not limited to, requirements for equipment, monitoring, sampling and reporting.
 - b. A list of equipment including, but not limited to, pumps, prime movers, and standby equipment.
 - c. A description of the proposed method of dewatering; water reinfiltration; containment; treatment discharge; and disposal; and installation, maintenance, and system removal procedures.
 - d. A description of erosion/sedimentation control measures and best management practices to eliminate or minimize impacts from potential pollutants.
3. Data for the required discharge reports, as applicable, shall be collected and maintained by the Contractor's Dewatering Professional. It shall consist of periodic sampling and analysis of system influents, midfluents and/or effluents and discharge quantities and other requirements of the relevant permits. The

Contractor's Dewatering Professional shall also coordinate analysis of samples at an appropriately certified analytical laboratory and shall comply with all permit reporting requirements.

4. Contractor shall submit a modified Dewatering Plan **within 24 hours**, if open pumping from sumps and ditches results in boils, loss of fines, softening of the ground or other adverse impacts on or off-site.

1.04 QUALITY ASSURANCE

- A. Provide in accordance with Section 01400 – Quality Control and as specified.
- B. Employ the services of a Dewatering Professional and a Massachusetts Registered Professional Engineer having the following qualifications:
 1. The Massachusetts Registered Professional Civil Engineer shall have completed the design of at least five (5) successful dewatering projects of equal size and complexity and with equal systems within the last five (5) years consisting of deep wells, well points, vacuum well points, and sump pumping for heavy Civil projects of similar size, type, and complexity in developed areas with trench box or steel/timber sheeting support of excavation systems.
 2. The dewatering system installer's supervisor shall have a minimum of 5 years experience in installation of well points, deep wells, recharge systems, or equal systems.
 3. The Dewatering Professional responsible for day to day operation of the system shall have the following minimum qualifications:
 - a. Completion of at least 5 successful dewatering projects of equal size and complexity with equal systems within the last five (5) years consisting of system operation and troubleshooting, collection of readings, maintenance of logs and other required documents, collection of samples, coordination of analysis of samples, and compliance with reporting requirements during pumping for heavy Civil projects of similar size, type, and complexity in developed areas.
 - b. Current certification from MassDEP to operate the proposed treatment system, as applicable.
- C. If subgrade soils are disturbed or become unstable due to dewatering operation or an inadequate dewatering system, notify the Engineer, stabilize the subgrade, and modify system to perform as specified at no additional cost to the Owner.
- D. If oil and/or other hazardous materials are encountered after dewatering begins, immediately notify the Engineer.

1.05 PROJECT/SITE CONDITIONS

- A. Environmental Conditions: Refer to Hazardous Materials Survey Appendix A.

- B. A subsurface investigation was not completed for this project. For boring logs from previous site investigations refer to Appendix E.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Dewatering equipment shall consist of all equipment specified in the Contractor's approved Dewatering Plan.
- B. Provide and store auxiliary dewatering equipment, consisting of pumps and hoses on the site in the event of breakdown, at least one (1) pump for every five (5) used.
- C. Provide dewatering equipment, including an appropriately sized settling tank, and maintain erosion/sedimentation control devices as indicated or specified and in accordance with the Dewatering Plan.
- D. Provide temporary pipes, hoses, flumes, channels, crushed stone, geotextile fabric, sedimentation barriers, or any combination of the above for the transport of discharge water over-ground to the discharge location.
- E. Provide sampling and analysis equipment to test for turbidity.

PART 3 - EXECUTION

3.01 GENERAL

- A. Execution of any earth excavation, installation of earth retention systems, and dewatering shall not commence until the related submittals have been submitted, approved by the Owner and Engineer, and the Dewatering Professional is on site and has begun the duties specified herein.
- B. Furnish, install, operate, and maintain dewatering, re-infiltration, treatment and discharge systems as indicated or specified and in accordance with the Dewatering Plan. Delays due to insufficient storage capacity, inadequate Contractor Dewatering Plan, or permitting delays will be at no additional cost to the Owner. The Contractor is responsible to evaluate available data and determine the necessary dewatering system so as not to impede construction activities.
- C. Carry out dewatering program in such a manner as to prevent undermining or disturbing foundations of existing structures or of work ongoing or previously completed.
- D. Do not excavate below the seasonal high groundwater elevation until the dewatering system is operational.
- E. Unless otherwise specified, continue dewatering uninterrupted until all structures, pipes, and appurtenances below the seasonal high groundwater level have been

completed and sufficiently backfilled and/or anchored such that they will not be floated or otherwise damaged by an increase in groundwater elevation.

- F. Discontinue open pumping from sumps and ditches, if such pumping is resulting in boils, loss of fines, softening of the ground, instability of the slopes or other adverse impacts on or off-site. Modify Dewatering Plan and submit to the Engineer at no additional cost to the Owner.
- G. Where subgrade materials are disturbed or become unstable due to dewatering operations, remove and replace the materials at no additional cost to the Owner.

3.02 DEWATERING DISCHARGE

- A. Groundwater or accumulated surface runoff to be infiltrated does need not be treated, unless known to be contaminated or noticeably impacted with oil or hazardous waste. Contractor shall provide infiltration as described in Section 1.02.A.3 that complies with relevant local, state and federal regulations.
- B. The effluent (discharge) shall be tested for turbidity on a daily basis and shall not exceed 280 NTU, averaged over 5 consecutive days. Sufficient measures shall be employed to provide effective ways to remove turbidity, color and potential coliform organisms (from sewer work) prior to discharge
- C. Transport pumped or drained water to discharge location in compliance with applicable permits and without interference to other work; damage to or contamination of pavement, other surfaces, or property; erosion; or siltation.
- D. Provide separately controlled pumping lines.
- E. Immediately notify the Engineer and Owner if groundwater is encountered that is suspected to be contaminated with substances other than those for which the treatment system has been designed. Do not pump water found to be contaminated with oil or other hazardous material to the discharge locations. Sampling, testing and characterization of the groundwater shall include (but not be limited to) criteria within part 1.2 of this specification section to determine the final disposal of the groundwater. Groundwater disposal shall follow all local, state and federal permits and regulations.

3.03 COMPLIANCE WITH DEWATERING AND RELATED PERMITS AND REGULATIONS

- A. Discharging groundwater and allowing for natural infiltration may not be a viable option for controlling groundwater in the project area. Should dewatering activities be required where the Contractor needs to discharge groundwater to a location other than the point of origin, then the Contractor shall store, treat and discharge the water in accordance with applicable permits and regulations. Periodic sampling, as may be required to demonstrate treatment effectiveness and compliance with pretreatment standards specified in any local, state, or federal discharge permit required shall be the responsibility of the Contractor and its Dewatering Professional. If on-site

infiltration, discharge to the local sanitary sewer system or off-site disposal are not feasible options, the Contractor shall be responsible for seeking coverage under one of the following EPA NPDES permits: Construction General Permit (CGP) for projects disturbing >1 acre; Dewatering General Permit (DGP) for projects disturbing <1 acre; or Remediation General Permit (RGP) for any project with known groundwater contamination. The Contractor shall be prepared to comply with standard local permit conditions including periodic testing of the effluent and with standard NPDES permit conditions including periodic testing of the treatment system influent, midfluent and effluent. The Dewatering Plan shall include a description of procedures and information related to the collection of readings, maintenance of logs and other required documents. At a minimum, the Dewatering Plan shall describe compliance with relevant provisions of the applicable NPDES Permit or other discharge permit and the local Conservation Commission Order of Conditions. Copies of the applicable NPDES or other permit authorization to discharge shall be provided to the Owner prior to the start of dewatering activities.

B. The Contractor, through its Dewatering Professional:

1. Shall furnish all labor, equipment and materials necessary to obtain accurate representative samples of the groundwater and for analysis for the set of analytical parameters specified above and as required by local, state and federal permits and regulations.
2. Shall coordinate sampling activities with the Engineer. The Engineer reserves the right to sample treated and untreated dewatering flows at any time.
3. Shall take readings from the treatment system in accordance with the Dewatering Plan.
4. Shall collect an initial sample of untreated and treated groundwater at the beginning of dewatering activities within the construction area. Sampling and start-up shall be conducted in accordance with applicable permits.
5. Shall prepare and keep in proper order all records required by regulatory authorities and permits.
6. Shall maintain logs and other records in accordance with the Specifications, regulatory agency and permit requirements, and the Dewatering Plan.
7. Shall coordinate analysis of samples by an appropriately certified analytical laboratory in accordance with the Specifications, regulatory agency and permit requirements, and the Dewatering Plan, and ensure that laboratory detection limits meet permit requirements.
8. Shall comply with reporting requirements in a timely manner and in the format required by the relevant permit. Reporting in compliance with permit requirements includes, but is not limited to: notification to the appropriate regulatory agencies, Owner and Engineer prior to discharge; submittal of laboratory analytical reports for each sampling event; submittal of reports for each reporting period during which no discharge occurs; notification of non-compliant discharges; notification of termination of discharge; and response to permit-related questions posed by regulatory agencies or the Owner and Engineer.

- a. If water will be discharged under a National Pollutant Discharge Elimination System (NPDES) permit, submit notifications and reports to both the Environmental Protection Agency (EPA) and the appropriate regional office of the Massachusetts Department of Environmental Protection (MassDEP) and the Engineer. Comply with pre-discharge notification, discharge reporting, notification of no discharge, and termination of discharge notification requirements; and respond to inquiries or correspondence from EPA or MassDEP regarding permit issues.
 - b. If water will be discharged under a local permit, submit notifications and reports as required in the permit.
 - c. Observe and record daily the elevation of the groundwater during the length of the dewatering operation and provide data to Engineer on daily basis. For monthly or less frequent reporting deadlines, provide the Engineer with copies of all reports fourteen (14) days prior to the reporting deadline, and submit reports to the appropriate agency(ies). Provide copies of other dewatering documents to the Engineer immediately.
9. Install and maintain erosion/sedimentation control devices at the point of discharge as indicated or specified and in accordance with the Dewatering Plan.
 10. The Contractor shall obtain all federal, state, county, and local permits and variances to allow transport of materials on public roadways, should such transport be necessary.
 11. The Contractor shall dispose of all wastes resulting from construction dewatering activities in accordance with local, federal and state regulations.
 12. The Contractor is solely responsible for the implementation of the permit requirements, and is solely responsible for any punitive action resulting from any violation of the permit. The actual permit issued shall become part of this Contract by either addendum or by change order. If the actual permit is included by change order, no additional costs for implementing the permit will be considered by the Owner, when the actual permit is issued.

3.04 REMOVAL

- A. Do not remove dewatering system without written approval from the Engineer.
- B. Backfill and compact sumps or ditches in accordance with Section 02200 – Earth Excavation, Backfill, Fill, and Grading.
- C. All dewatering wells shall be abandoned upon completion of the work, and completely backfilled with cement grout.

END OF SECTION 02140

SECTION 02149

MAINTAINING EXISTING FLOW

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Requirements to maintain existing flow and implement and complete all flow diversions and/or bypass pumping required to complete the Work indicated on the Drawings.
- B. Clean upstream sewers after bypass is removed. The cleaning is intended to remove any solids that have accumulated in the upstream sewer while the station was under bypass.

1.02 PERFORMANCE REQUIREMENTS

- A. It is essential to the operation of the existing sewerage system that there be no interruption of the wastewater flow throughout the duration of this project. An interruption shall be considered, but may not be limited to, any condition that in the sole opinion of the Engineer adversely affects or alters operation of the existing sewage system and/or any other portion or component of the existing system including the associated flows; allows the level of sewage flow to increase, rise, collect, surcharge and/or overflow existing facilities in any manner; or results in any operational or permit violations being issued to the Owner.
- B. The Contractor shall provide, maintain, and operate temporary facilities such as dams, bulkheads, pumping equipment (both primary and backup units as required) conduits, electrical power, diesel fuel, and all other labor and equipment to intercept and maintain the existing sewage flow before it reaches the point where it would interfere with his work, carry it past his work, and return it to the existing facilities beyond his work.
- C. The Contractor's attention is directed to the fact that increases in normal flow should be expected during periods of wet weather. The Contractor shall therefore take all precautions necessary including monitoring weather forecasts to fully accommodate, control and sufficiently handle the increases in flow during periods of wet weather and/or storms as well as periods of normal flow.
- D. The Engineer may prohibit the carrying out of any work at any time when, in his sole judgment, increased flow conditions are unfavorable or not suitable, or at any time, regardless of the existing flows, when proper precautions are not being taken to safeguard the existing sewerage system, previously constructed work, work in progress and/or the general public.
- E. 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 to enable uninterrupted bypass pumping or as the Owner may require, at no additional expense to the Owner.
- F. Damage to public or private property resulting from a sanitary sewer overflow caused by failure of the wastewater bypass system shall be restored to match existing conditions at the Contractor's expense.

- G. The Contractor shall pay any fine associated with a sanitary sewer overflow caused by failure of the wastewater bypass system.
- H. The Contractor shall provide a system capable of bypassing the following wastewater flow scenarios:

Phase 1 Bypass:

West SMH

Flow Range: 0.3 MGD to 3.4 MGD

SMH Invert Elevation: 143.0 Feet

Discharge Elevation: 162.4 feet

16-Inch Diameter Forcemain Length; 4,700 linear feet

Maintain Wastewater Level = 145.0

High Alarm Level = 146.5

High-High Alarm Level = 147.5

South SMH

Flow Range: 0.1 MGD to 1.4 MGD

SMH Invert Elevation: 143 feet

Discharge Elevation: 162.4 feet

16-Inch Diameter Forcemain Length; 4,700 linear feet

Maintain Wastewater Level = 145.0

High Alarm Level = 146.5

High-High Alarm Level = 147.5

Phase 2 Bypass:

Wet Well

Flow Range: 0.4 MGD to 4.8 MGD

SMH Invert Elevation: 138.3 Feet

Discharge Elevation: 162.4 feet

16-Inch Diameter Forcemain Length; 4,700 linear feet

Maintain Wastewater Level = 141.3

High Alarm Level = 143.3

High-High Alarm Level = 145.3

- I. The bypass systems shall be hydraulically designed to consider discharge into the common forcemain with parallel and individual pump operation.
- J. Refer to the Contract Drawings for a Recommended Sequence of Bypass.
- K. The bypass system shall be equipped with a doppler style flowmeter (Greyline DFM 6.1 or equal with 50-foot sensor cord, stainless sensor mounting strap, and sensor lube) purchased for the project, installed on the bypass system and supplied to the OWNER following completion of the bypass. The flowmeter shall be equipped with a transmitter and be capable of instantaneous flow measurement, flow totalization and data logging.
- L. The bypass system shall be equipped with an alarm notification system. The Contractor shall be required to respond within **one half (1/2) hour** to any bypass system alarm or emergencies 24-hours a day, 7 days a week, 365 days a year.

M. The City will provide a temporary RTU to obtain alarms, run status, etc. from the bypass system. The contractor shall provide power to the RTU, control wiring in conduit from the temporary bypass to the RTU, land wires were directed by the City's I&C integrator, testing and any ancillary items not specifically noted that are required to complete the work. Control wiring shall be provided for the alarms listed in Section 2.01.G.2.

N. Sulfide Control

1. The MWRA sulfide limit in the Framingham wastewater collection system is 0.3 mg/L. The Contractor is required to meet this sulfide limit for bypassed flows at the WRPS. Bioxide is currently used by the City to control the formation of sulfides in the WRPS force main.
2. The Contractor shall provide storage tanks, Bioxide, metering pumps, piping and appurtenances to add Bioxide into each suction manhole and/or the wet well while on bypass.
3. Between April 15th and November 15th Bioxide shall be metered into the manholes or wet well at a rate of 15 gallons per day.

O. Level Monitoring

1. Level control and monitoring shall be provided for each bypass system to provide the alarms specified in 2.01.G.2,
 - a. A secondary level monitor with alarm call out shall be provided in the first upstream manhole for both bypass system (two locations). The secondary high-level alarm shall be integrated into the monitoring system and call out when activated.

1.03 SUBMITTALS

A. In accordance with SECTION 01300 submit the following:

1. The Contractor shall submit for approval a sequence of installation, operation, and decommissioning for the bypass pumping system. A suggested sequence is presented on Sheet C-3 of the Contract Drawings.
2. Detailed plans and descriptions outlining all provisions and precautions to be taken regarding the control and handling of existing sewage flows.
3. Include such items as schedules, locations, elevations, capacities of equipment, materials, traffic maintenance plans, and all other incidental items necessary and/or required by the Owner to ensure proper protection of the facilities and compliance with the requirements herein specified.
4. Qualifications as described herein.
5. Detailed proposal for noise prevention measures for review.
6. Detailed proposal for bypass system cold weather freeze protection.
7. Shop drawings for all pumping, piping, and appurtenances for type and size of equipment required to perform the flow diversion and/or bypass pumping work as required herein.
8. Alarm notification and response plan. Plan to include response times and names and telephone numbers of people responsible for maintaining the pumping system.
9. One-line electrical drawing and site layout for powering pumps and appurtenances.

- B. The Engineer reserves the right to limit and/or otherwise restrict the Contractor's overall proposal and/or operations without claim from the Contractor should the Engineer deem it to be in the Owner's or public's best interest to do so.

1.04 QUALITY ASSURANCE

A. Qualifications

1. The design, installation and operation of the temporary pumping system shall be the Contractor's responsibility. The Contractor shall employ the services of a vendor who can demonstrate to the Engineer that he specializes in the design and operation of temporary bypass pumping systems. The vendor shall provide at least five (5) references of projects of similar size and complexity in wastewater applications performed by his firm within the past three years within New England. The bypass system shall meet the requirements of codes and regulatory agencies having jurisdiction.
2. The vendor shall demonstrate the bypass pumping equipment is automated and is capable of functioning without the assistance of an operator.
3. The vendor shall demonstrate the pumping equipment can operate for an extended period of time running dry. After this period of time, the pump shall have the capability of pulling a 25" Hg vacuum without adjustment or repair.
4. The vendor shall demonstrate sufficient service resources and repair parts in stock to fulfill service or repair of rental equipment within one hour of a service call, twenty-four hours per day, seven days per week.
5. Temporary components of the bypass system including pumps, pipe, hose, valves, flow meter, and fittings shall be provided by one bypass vendor. Hydraulic calculations and drawings required by the submittals shall be provided by the bypass vendor and stamped and certified by a Professional Engineer licensed in the State of Massachusetts.

B. Pre-Installation Meeting

1. Contractor to schedule and attend a pre-installation meeting with the vendor, Owner and Engineer prior to installation of bypass system.

PART 2 PRODUCTS

2.01 EQUIPMENT

- A. At a minimum, all equipment shall be supplied in duplicate for emergency situations. Provide adequate on-line backup facilities so that no interruption in service is encountered. Equipment and installation are subject to the approval of the Owner and the Engineer.

B. Pumping System(s)

1. All pumping units (primary and secondary) and appurtenances shall be sized properly to handle the flows encountered including increased flows due to wet weather.
2. Pumps shall be centrifugal, end suction, fully automatic self-priming pumps that do not require the use of foot-valves, vacuum pumps, diaphragm pumps, or isolation valves in the priming system. The pumps may be electric or diesel powered. **Note, the Contractor is required to obtain and pay for a temporary electric service if electric is utilized.** The cost for electricity and diesel fuel are the responsibility of the Contractor.

Pumps must be constructed to allow running dry for long periods of time to accommodate the cyclical nature of effluent flows and shall immediately develop 25" Hg vacuum without adjustment or repair or employ level control devices to regulate on/off or variable speed of the pump. Pumps shall be CD low noise units as manufactured by Godwin Pump of America, Inc, or approved equal. All pumping units and appurtenances shall be sized in accordance with the design parameters provided. Pumps shall not be connected by a common suction manifold.

3. Seals shall be high pressure, mechanical self-adjusting type with silicon carbide faces capable of withstanding suction pressures to 100 psi running. The mechanical seal shall be cooled and lubricated in an oil bath reservoir, requiring no maintenance or adjustment. Pump shall be capable of running dry, with no damage, for extended periods of time. All metal parts shall be of stainless steel. Elastomers shall be Viton.
4. The Contractor shall provide the necessary start/stop controls for each pump.
5. The Contractor shall be responsible to meet noise requirements in paragraph 2.01F in this section. All diesel driven primary and standby pumps shall be sound attenuated. The use of Critical Silenced Canopy pumps or acoustical Whisper Pac enclosures for sound attenuation is required.

C. Piping System(s)

1. All piping systems (primary and secondary) and appurtenance shall be sized properly to handle the flows encountered including the specified peak flows due to wet weather.

D. Power Generating Facilities

1. Include power generating facilities capable of providing all power necessary to operate any primary and secondary pumping systems.
2. Maintain facility to be ready for use if required.

E. Flowmeter

1. The bypass system shall be equipped with a calibrated doppler style flowmeter purchased for the project, installed on the bypass system and supplied to the OWNER following completion of the bypass. The flowmeter shall be equipped with a transmitter and be capable of instantaneous flow measurement, flow totalization and data logging.
2. Doppler flowmeter shall be a DFM 6.1, manufactured by Greyline Instruments, Inc., or approved equal. The flowmeter shall be supplied with a 50-foot transducer cable length, 110 volt power outlet cable and all necessary brackets and appurtenances required for installation on the bypass system discharge piping.

F. Noise Prevention

1. Noise prevention measures for all equipment shall be used to ensure minimum noise impact or surrounding areas.
2. Measures may include but shall not be limited to enclosures, insulation, electric pumping units, and hospital grade silencers or mufflers.
3. Noise abatement shall be provided to maintain compliance with the City of Framingham's Nuisance Noise Ordinance provided in Appendix F.
4. Compliance with the noise ordinance shall be confirmed during the testing phase prior to taking the existing station off-line.
5. Should at any time prior to or during the performance of above-mentioned work, the Engineer determines the noise prevention measures being used are not adequate, the Contractor shall at no additional cost to the Owner suspend construction until acceptable measures are incorporated.

G. ALARM SYSTEM AND RESPONSE

1. Pumping system shall be equipped with an alarm system capable of remote notification. Notification shall be automatic to a preprogrammed list approved by the Owner/Engineer.
2. At a minimum the following call-out alarms shall be provided.
 - a. Low / No Flow
 - b. Pump Fail to Start
 - c. High Level
 - d. High-High Level
 - e. Power Outage
 - f. Low Temperature (one for each bypass pump and one on the discharge connection to the force main)
3. Provide a NEMA 4X enclosure to house the City furnished RTU and temporary wiring to tie alarms into the City's SCADA system.
4. Local alarm notification shall consist of a red strobe.

H. Bypass System Operator

1. Personnel operating the bypass system shall have a minimum of 3-years experience at operating and maintaining wastewater bypass systems.
2. The system operator and personnel responding to alarms shall be fully trained on all bypass equipment and have the ability to trouble shoot/repair the bypass system equipment when required.

PART 3 EXECUTION

3.01 PUBLIC SAFETY AND CONVENIENCE

A. General

1. The Contractor shall at all times keep the streets, highways, roads, driveways, parking lots, private walks, and public sidewalks open for pedestrian and vehicular traffic unless otherwise authorized by the Owner/Engineer.

B. Public Travel Ways

1. Any authorized temporary closure of any streets, Mass DOT highways or roads shall be coordinated with Mass DOT, the local Fire, Police and/or Department of Public Works as required by the municipality.

C. Municipal, Commercial and Private Property

1. Any authorized, temporary closure of any municipal, commercial or private driveway or access route will require the Contractor provide 48 hour notice to the City of the temporary restriction of access to their property. The Contractor will make every attempt to schedule his work with as little inconvenience to the property owner as possible

3.02 SEQUENCE

- A. The Contractor shall follow the approved sequence of installation, operation, and decommissioning for the bypass pumping system.

3.03 INSTALLATION

- A. Keep the Engineer advised at all times of any changes made to the overall operation(s) to accommodate field conditions.
- B. Flow diversions and/or bypass pumping shall be maintained at all times as long as it is necessary to maintain the flow through the limits of the project during construction.
- C. Maintain auxiliary and/or emergency equipment at the site to continue flow diversion and/or bypass pumping operations in the event of a breakdown and/or loss of normal power.
- D. The Contractor shall be responsible for the proper functioning and operation of the backup pumping units. Back-up pump(s) shall be on-line, isolated from the primary system by a valve.
- E. No work shall begin until all provisions and requirements of this Section have been reviewed and approved by the Engineer.
- F. The Engineer reserves the right to limit and/or otherwise restrict the Contractor's overall activities and/or operations at any time without claim should the Engineer deem it to be in the Owner's or public's best interest to do so.
- G. The Contractor shall test bypass pumps in continuous automatic operation for a duration of 3 days, not including weekends, before taking the existing pumping station offline for demolition.
- H. Bypass system shall remain onsite fully functional until new station operates continuously for 7 days uninterrupted in automatic mode and after Owner's and Engineer's acceptance of all field and functional testing.

3.04 POST BYPASS CLEANING

- A. The upstream sewer shall be cleaned for a distance of 300-feet on both the south and west influent sewer.
- B. Cleaning shall be completed at night during periods of low flow between the hours of 10:00 pm and 5:00 am.
- C. Cleaning shall be in accordance with Specification 02763.
- D. Solids and debris removed from the influent sewer shall be disposed of as Special Waste in accordance with Specification 02767.
- E. Wastewater shall be decanted from the Vactor truck to an upstream manhole approved by the Owner and the Engineer. No solids shall be discharged to the sewer system.
- F. The Contractor's price shall include disposal of up to 5 Ton of Special Waste.

END OF SECTION

SECTION 02200

EARTH EXCAVATION, BACKFILL, FILL AND GRADING

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes

1. Requirements for; excavating in earth for trenches and structures; backfilling excavations; furnishing necessary material; compaction; constructing embankments and fills; miscellaneous earth excavations and miscellaneous grading.
2. Impacted soil and groundwater are present within the limit of work. See Specification 02080 – Soil and Waste Management and Section 02140 Dewatering for requirements.

B. Related Sections

1. Section 01410 – Testing Laboratory Services
2. Section 02080 – Soil and Waste Management
3. Section 02100 – Site Preparation
4. Section 02140 - Dewatering
5. Section 02215 - Aggregate Materials
6. Section 02272 – Geotextile Materials
7. Section 03300 - Cast-In-Place Concrete

1.02 REFERENCES

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

1. D1557, Standard Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10-lb. (4.54 kg) Rammer and 18-inch (457 mm) Drop. Wherever a percentage of compaction is indicated or specified, use percent of maximum density at optimum moisture as determined by Procedure C.

1.03 MEASUREMENT AND PAYMENT PROCEDURES

A. Test Pits

1. Test pits are indicated on the Drawings. The cost for these test pits shall be included in the Lump Sum cost for Item No. 1.

1.04 QUALITY ASSURANCE

A. Field Samples

1. Provide samples of materials as requested by the Engineer, to the Quality Control Engineer hired by the Owner, prior to delivery of materials on site, in order to facilitate field testing of compaction operations and material properties.

1.05 PROJECT/SITE CONDITIONS

A. Existing Conditions

1. There are pipes, drains, and other utilities in locations not indicated on drawings, no attempt has been made to show all services, and completeness or accuracy of information given is not guaranteed.

1.06 MAINTENANCE

- A. Maintain all work in accordance with SECTION 01800.

PART 2 PRODUCTS

2.01 MATERIALS

A. Suitable Aggregate

1. The nature of materials will govern both acceptability for backfill and methods best suited for placement and compaction.
2. All material whether from excavations or from borrow, after being placed and properly compacted, will make a dense stable fill and containing no vegetation, roots, stones over 6 inches in diameter, or porous matter.
3. Organic matter to be well distributed and not to exceed minor quantities.

B. Trench and Excavation Backfill

1. In general, and unless other material is indicated on drawings or specified, material used for backfilling trenches and excavations shall be suitable material which was removed in the course of making the construction excavations. If sufficient suitable material is not available from the excavations, the backfill material shall be screened gravel, bank-run or selected borrow as directed in according to respective Specification Sections.

C. Structure Backfill

1. Unless otherwise indicated or specified, all fill and backfill under structures and pavement adjacent to structures shall be compacted bank-run gravel containing not more than 10 percent material passing a 200 sieve. When coarse aggregate and fine aggregate are indicated or specified for use under structures, they shall conform to the requirements for coarse and fine aggregate specified in Section 03300.

D. Filling and Embankment Backfill

1. Suitable selected materials available from the excavations and not required for backfill around pipes or against structures may be used for filling and building embankments, except as otherwise specified. Material needed in addition to that available from construction operations shall be obtained from suitable gravel banks or other suitable deposits. The Contractor shall furnish, at his own expense, all borrow material needed on the work.

E. Additional materials

1. Concrete: In accordance with SECTION 03300.
2. Screened gravel: In accordance with SECTION 02215.
3. Bank-run gravel: In accordance with SECTION 02215.
4. Selected borrow: In accordance with SECTION 02215.

2.02 EQUIPMENT

A. Well Points

1. Designed to drain soil and prevent saturated soil from flowing into excavation.

B. Pumping Units

1. Designed for use with the wellpoints, capable of maintaining a high vacuum and, handling large volumes of air and water at the same time.

C. Underdrain Pipe

1. HDPE pipe enclosed in crushed stone encased in filter fabric.
2. Sewer pipe of quality know as "seconds".

2.03 SOURCE QUALITY CONTROL

- A. Provide Engineer with access to location of off-site sources of materials.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify all existing utilities and facilities prior to excavation.

3.02 PROTECTION

A. Utilities

1. Support and protect from damage existing pipes, poles, wires, fences, curbing, property line markers, and other structures, which the Engineer decides must be preserved in place without being temporarily or permanently relocated.
2. Restore items damaged during construction without compensation, to a condition at least equal prior to construction.

B. Trees

1. Enclose the trunks of trees adjacent to work with substantial wooden boxes of height necessary to protect trees from injury from piled material, equipment, operations or otherwise.
2. Employ excavating machinery and cranes of suitable type and size and operate with care to prevent injury to trees not to be cut and particularly to overhanging branches and limbs.
3. When trimming is required, make all cuts smooth and neat without splitting or crushing.
4. Cover cut areas with an application of grafting wax or tree healing paint.
5. Branches, limbs, and roots shall not be cut except by permission of the Engineer.

C. Plantings

1. Protect by suitable means or temporarily replant and maintain cultivated hedges, shrubs, and plants which may be injured by the Contractor's operations
2. Replant in their original positions and care for until growth is re-established, once the construction operations have been substantially completed.
3. If cultivated hedges, shrubs, and plants are injured to such a degree as to affect their growth or diminish their beauty or usefulness, they shall be replaced by items of kind and quality at least equal to which existed prior to the start of the Work.

D. Paved surfaces

1. Do not use or operate tractors, bulldozers, or other power-operated equipment with treads or wheels shaped as to cut or injure paved surfaces.

2. All surfaces which have been injured by the Contractor's operations shall be restored to a condition at least equal to which existed prior to start of the Work.
3. Suitable materials and methods shall be used for such restoration.

3.03 PREPARATION

A. Pavement Removal

1. Remove only existing pavement as necessary for the prosecution of the Work.
2. Engineer may require that pavement be cut with pneumatic tools or saws without extra compensation to Contractor, where in the opinion of the Engineer it is necessary to prevent damage to the remaining road surface.
3. Dispose large of pieces of broken pavement before proceeding with excavation.

B. Top Soil Removal

1. From areas which excavations are to be made, loam and topsoil shall be carefully removed and separately stored to be used again as directed; or, if the Contractor prefers not to separate surface materials, he shall furnish, as directed, loam and topsoil at least equal in quantity and quality to that excavated.

C. Subgrade

1. Remove loam and topsoil, loose vegetable matter, stumps, large roots, etc., from areas where embankments will be built or material will be placed for grading.
2. Shape as indicated on the drawings and prepare by forking, furrowing, or plowing to bond first layer of the new material placed.

3.04 RELOCATION AND REPLACEMENT OF EXISTING STRUCTURES

A. The structures to which the provisions of this article apply include pipes, wires, and other structures which meet all of the following:

1. Are not indicated on the drawings or otherwise provided for.
2. Encroach upon or are encountered near and substantially parallel to the edge of the excavation.
3. In the opinion of the Engineer will impede progress to such an extent that satisfactory construction cannot proceed until they have been changed in location, removed (to be later restored), or replaced.

B. In removing existing pipes or other structures, the Contractor should use care to avoid damage to materials, and the Engineer shall include for payment only those new materials which, in his judgment, are necessary to replace those unavoidably damaged.

- C. Whenever the Contractor encounters certain existing structures as described above and is so ordered in writing, he shall do the whole or such portions of the work as he may be directed to change the location of, remove and later restore, or replace such structures, or to assist the Owner thereof in so doing. For all such work, the Contractor shall be paid under such items of work as may be applicable, otherwise as Extra Work.
- D. When fences interfere with the Contractor's operations, he shall remove and (unless otherwise specified) later restore them to a condition which existed prior to the start of the Work, all without additional compensation. The restoration of fences shall be done as promptly as possible and not left until the end of the construction period.

3.05 SHEETING AND BRACING

- A. Furnish, put in place, and maintain such sheeting, bracing, etc., as necessary to support the sides of the excavation and to prevent any movement of earth which could in any way diminish the width of the excavation to less than that necessary for proper construction, or could otherwise injure or delay the work, or endanger adjacent structures.
- B. Whenever possible, sheeting shall be driven ahead of the excavation to avoid loss of material from behind the sheeting. If it is necessary to excavate below the sheeting, care shall be taken to avoid trimming behind the face along which the sheeting will be driven. Care shall be taken to prevent voids outside of the sheeting, but, if voids occur, they shall be filled immediately with sand and compacted.
- C. Leave in place to be embedded in the backfill, or concrete, all sheeting, bracing, etc., which is indicated on the drawings to be left in place. Leave in place any and all other sheeting, bracing, etc., which the Engineer may direct to leave in place, at any time during the progress of the work, for the purpose of preventing injury to structures or property.
- D. The Engineer may direct that sheeting and bracing to be left in place be cut off at any specified elevation.
- E. All sheeting and bracing not to be left in place shall be carefully removed in such manner as not to endanger the construction or other structures. All voids left or caused by the withdrawal of sheeting shall be backfilled immediately using suitable materials and compaction methods.

3.06 DEWATERING

- A. Refer to Specification 02140 – Dewatering.

3.07 EXCAVATION

- A. Execute operation of dewatering, sheeting and bracing without undermining or disturbing foundations of existing structures or of work previously completed under this contract.
- B. Excavate to widths that provide suitable room for:
 - 1. Building structures or laying and jointing piping.
 - 2. Placing all sheeting, bracing, and supports.
 - 3. Cofferdamming, pumping and draining.
- C. Render bottom of excavations firm, dry and acceptable in all respects.
- D. Do not plow, scrap or dig by machinery, earth at finished subgrade which results in disturbance of material below subgrade, unless indicated or specified, and remove with pick and shovel, last of material to be excavated, just before placing pipe, masonry or other structure.
- E. Make all excavations in open, except as otherwise specified or permitted.
- F. Excavation Near Existing Facilities
 - 1. As the excavation approaches pipes, conduits, or other underground structures, digging by machinery shall be discontinued and the excavation shall be done by means of hand tools. Such manual excavation when incidental to normal excavation shall be included in the work to be done under items involving normal excavation.
- G. Unauthorized Excavation
 - 1. If the bottom of any excavation is taken out beyond the limits indicated or prescribed, the resulting void shall be backfilled at the Contractor's expense with thoroughly compacted, screened gravel, if the excavation was for a pipeline, or with Class B concrete, if the excavation was for a masonry structure.
- H. Unsuitable Material
 - 1. If material unsuitable for foundation (in the opinion of the Engineer) is found at or below the grade to which excavation would normally be carried in accordance with the drawings and/or specifications, the Contractor shall remove such material to the required width and depth and replace it with thoroughly compacted, gravel borrow or crushed stone as directed.

3.08 STOCKPILING

- A. Stockpiles of excavated natural soils shall always be kept separate from excavated fill materials. Stockpiles of natural soils shall be covered with 6 mil polyethylene.
- B. Excavated fill materials stockpiled shall be placed on 6 mil polyethylene and covered with 6 mil polyethylene.
- C. The Contractor is responsible for all construction, protection, movement, and maintenance of stockpiles. Once the stockpiles have been removed the Contractor is responsible for proper disposal of all covers and liners.

A. .

3.09 TRENCHING

A. Trench Excavation

- 1. Where pipe is to be laid in gravel bedding or concrete cradle, the trench may be excavated by machinery to, or to just below, the designated subgrade, provided that the material remaining at the bottom of the trench is no more than slightly disturbed, as approved by the Engineer.
- 2. Where pipe is to be laid directly on the trench bottom, the lower part of trenches in earth shall not be excavated to subgrade by machinery, but, just before the pipe is to be placed, the last of the material to be excavated shall be removed by means of hand tools to form a flat or shaped bottom, true to grade, so that the pipe will have a uniform and continuous bearing and support on firm and undisturbed material between joints except for limited areas where the use of pipe slings may have disturbed the bottom.

B. Depth Of Trench

- 1. Excavate trench to depths permitting the pipe to be laid at the elevations, slopes, or depths of cover indicated on the drawings, and at uniform slopes between indicated elevations.

C. Width Of Trench

- 1. Excavate trench as narrow as practicable and do not widen by scraping or loosening materials from the sides. Every effort shall be made to keep the sides of the trenches firm and undisturbed until backfilling has been completed and consolidated.
- 2. Excavate trenches with approximately vertical sides between the elevation of the center of the pipe and an elevation 1 ft. above the top of the pipe.

D. Trench Excavation In Fill

1. If pipe is to be laid in embankments or other recently filled material, the material shall first be placed to the top of the fill or to a height of at least 1 ft. above the top of the pipe, whichever is the lesser. Particular care shall be taken to ensure maximum consolidation of material under the pipe location. The pipe trench shall then be excavated as though in undisturbed material.
- E. Length of trench open at any one time will be controlled by conditions, subject to any limits that may be prescribed by Engineer.

3.10 BACKFILLING

A. General

1. Frozen material shall not be placed in the backfill nor shall backfill be placed upon frozen material. Previously frozen material shall be removed or shall be otherwise treated as required, before new backfill is placed.

B. Fill And Backfill Under Structures

1. The fill and backfill materials shall be placed in layers not exceeding 6 in. in thickness. Unless otherwise indicated or specified, each layer shall be compacted to 95 percent in accordance with ASTM D1557.

C. Backfilling Around Structures

1. Do not place backfill against or on structures until they have attained sufficient strength to support the loads (including construction loads) to which they will be subjected, without distortion, cracking, or other damage. As soon as practicable after the structures are structurally adequate and other necessary work has been done, special leakage tests, if required, shall be made. Promptly after the completion of such tests, the backfilling shall be started and then shall proceed until its completion. Only soil meeting the requirements of suitable soil shall be used around the structure. Unequal soil pressures shall be avoided by depositing the material evenly around the structure.
2. The material shall be placed and compacted to 90 percent in accordance with ASTM D1557 unless otherwise indicated or specified.

D. Backfilling Pipe Trenches

1. As soon as practicable after the pipes have been laid and the joints have acquired a suitable degree of hardness, if applicable, or the structures have been built and are structurally adequate to support the loads, including construction loads to which they will be subjected, the backfilling shall be started and thereafter it shall proceed until its completion.
2. With the exception mentioned below in this paragraph, trenches shall not be backfilled at pipe joints until after that section of the pipeline has successfully passed any specified tests required. Should the Contractor wish to minimize the

maintenance of lights and barricades and the obstruction of traffic, he may, at his own risk backfill the entire trench, omitting or including backfill at joints as soon as practicable after the joints have acquired a suitable degree of hardness, if applicable, and the related structures have acquired a suitable degree of strength. He shall, however, be responsible for removing and later replacing such backfill, at his own expense, should he be ordered to do so in order to locate and repair or replace leaking or defective joints or pipe.

3. No stone or rock fragment larger than 6 in. in greatest dimension shall be placed in the backfill nor shall large masses of backfill material be dropped into the trench in such a manner as to endanger the pipeline. Pieces of bituminous pavement shall be excluded from the backfill.
4. Zone Around Pipe
 - a. Backfilled with the suitable materials and to the limits indicated on the drawings.
 - b. Material shall be compacted to 90 percent by tamping.
5. Remainder of Trench
 - a. Compact by tamping, in accordance with the nature of the material to 95 percent in accordance with ASTM D1557. Tamping with the excavator will not be permitted.
6. Excavated material which is acceptable to the Engineer for surfacing or pavement subbase shall be placed at the top of the backfill to such depths as may be specified elsewhere or as directed. The surface shall be brought to the required grade and stones raked out and removed.

E. Placing And Compacting Embankment Material

1. After the subgrade has been prepared as hereinbefore specified, the material shall be placed thereon and built up in successive layers until it has reached the required elevation.
2. Layers shall not exceed 12 in. in thickness before compaction. In embankments at structures, the layers shall have a slight downward slope away from the structure; in other embankments the layers shall have a slight downward slope away from the center. In general, the finer and less pervious materials shall be placed against the structures or in the center, and the coarser and more pervious materials, upon the outer parts of embankments.
3. Each layer of material shall be compacted by the use of approved rollers or other approved means so as to secure a dense, stable, and thoroughly compacted mass. At such points as cannot be reached by mobile mechanical equipment, the materials shall be thoroughly compacted by the use of suitable power-driven tampers.
4. Previously placed or new materials shall be moistened by sprinkling, if required, to ensure proper bond and compaction. No compacting shall be done when the

material is too wet, from either rain or too great an application of water, to compact it properly; at such times the work shall be suspended until the previously placed and new materials have dried out sufficiently to permit proper compaction, or such other precautions shall be taken as may be necessary to obtain proper compaction.

5. The portion of embankments constructed below proposed structures shall be compacted to 95 percent in accordance with ASTM D1557. The top 2 ft. of an embankment below a pavement base shall be compacted to 95 percent. All other embankments shall be compacted to 90 percent in accordance with ASTM D1557.

3.11 METHODS OF COMPACTION

A. Tamping and Rolling

1. Deposit backfill material and spread in uniform, parallel layers not exceeding 12 in. thick before compaction. Before the next layer is placed, each layer shall be tamped to obtain a thoroughly compacted mass. Care shall be taken that the material close to the bank, as well as in all other portions of the trench, is thoroughly compacted. When the trench width and the depth to which backfill has been placed are sufficient to make it feasible, and it can be done effectively and without damage to the pipe, backfill may, on approval, be compacted by the use of suitable rollers, tractors, or similar power equipment instead of by tamping. For compaction by tamping (or rolling), the rate at which backfilling material is deposited in the trench shall not exceed that permitted by the facilities for its spreading, leveling, and compacting.
2. If necessary to ensure proper compaction by tamping (or rolling), the backfill material shall first be wet by sprinkling. However, no compaction by tamping (or rolling) shall be done when the material is too wet either from rain or too great an application of water to be compacted properly; at such times the work shall be suspended until the previously placed and new materials have dried out sufficiently to permit proper compacting, or such other precautions shall be taken as may be necessary to obtain proper compaction.

B. Miscellaneous Requirements

1. Whatever method of compacting backfill is used, care shall be taken that stones and lumps shall not become nested and that all voids between stones shall be completely filled with fine material. Only suitable quantities of stones and rock fragments shall be used in the backfill; the Contractor shall, as part of the work done under the items involving earth excavation and rock excavation as appropriate, furnish and place all other necessary backfill material.
2. All voids left by the removal of sheeting shall be completely backfilled with suitable materials, and thoroughly compacted.

3.12 DISPOSAL OF SURPLUS EXCAVATED MATERIALS

- A. No excavated materials shall be removed from the site of the work or disposed of by the Contractor except as directed or permitted by the Engineer.
- B. Surplus excavated materials suitable for backfill shall be used to backfill normal excavations in rock or to replace other materials unacceptable for use as backfill all as directed or permitted and without additional compensation.
- C. Surplus excavated materials not needed as specified above shall be hauled away and dumped by the Contractor, at his expense, at appropriate locations, and in accordance with arrangements made by him. See Specification Section 02080 for soil management requirements. Approval from the Owner and Engineer must be obtained prior to hauling excavated materials offsite. Soils cannot leave the City without authorization and proper documentation.

3.13 DISPOSAL OF SPECIAL WASTES

- A. The Contractor's attention is directed to the requirements set forth by the State of Massachusetts, Department of Environmental Protection, (MA DEP) regarding "Special Wastes" and the proper disposal thereof. All waste materials and debris, as designated by the Owner and/or Engineer, including but not limited to any sewers, storm drains, catchbasins, and combined system pipelines and associated structures, or any portions thereof, including but not limited to sludge, grit, sediment, dirt, sand, rock, grease, roots and other liquid, solid or semi-solid materials contained therein, shall be considered "Special Wastes." In addition, any excavated soils contaminated in any manner, as designated by the Owner and/or Engineer, shall also fall under this category and shall be handled the same. When so encountered, all such materials and debris shall be removed to the extent so ordered by the Engineer and properly disposed of in strict compliance with the requirements of the MA DEP and other regulating authorities to an approved and certified waste disposal site. It shall remain the sole responsibility of the Contractor to apply for and obtain all required permits, bonds and/or insurance relative to such disposal. The Contractor shall also pay all costs associated with the disposal, required permits, bonds and insurance with no additional expense to the Owner. All handling of such "Special Waste" shall be done in strict compliance with the MA DEP requirements and/or any other federal, state or local agency having jurisdiction or authority over the same. Under no circumstances shall sewage, solids or other "Special Wastes" removed from the sewer lines be dumped or spilled onto the streets or into ditches, catch basins or storm drains. The Contractor must use watertight and State approved vehicles in transporting any wastes as hereinbefore designated.
- B. The Contractor shall indemnify and save harmless the Owner and Engineer and all persons acting for or on behalf of the Owner and Engineer from all claims and liability of any nature or kind, and all damages, costs and expenses, including attorney's fees and penalties, arising from the improper handling, transportation or

disposal of "Special Wastes" as determined by the MA DEP and/or any other federal, state or local agency having jurisdiction or authority over the same.

3.14 DUST CONTROL

- A. During the progress of the Work, maintain the area of activities, by sweeping and sprinkling of streets to minimize the creation and dispersion of dust. If the Engineer decides that it is necessary to use calcium chloride for more effective dust control, the Contractor shall furnish and spread the material, as directed.

3.15 BRIDGING TRENCHES

- A. Provide suitable and safe bridges and other crossings where required for the accommodation of travel, and to provide access to private property during construction. Remove once bridges and crossings are no longer needed.

3.16 FIELD QUALITY CONTROL

A. Site Tests

1. In accordance with SECTION 01410
2. The Contractor shall provide third party nuclear density soil compaction testing at a minimum of four locations as directed by the Owner/Engineer.

3.17 CARE AND RESTORATION OF PROPERTY

- A. Restoration of existing property or structures done as promptly as practicable and not left until the end of the construction period.

END OF SECTION

SECTION 02215

AGGREGATE MATERIALS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes

1. Requirements for furnishing and placing materials, which include Crushed Stone, Gravel Borrow and Select Borrow.
2. Location of specified materials as detailed on the Drawings or as directed by the Engineer for excavation below normal depth, utility support, replacement of unsuitable material or elsewhere, as ordered.

B. Related Sections

1. Section 02200 - Earth Excavation, Backfill, Fill and Grading.
2. Section 02500 - Paving

1.02 REFERENCES

A. American Association of State Highway and Transportation Officials (AASHTO).

1. T11, Amount of Material Finer than 0.075 mm Sieve in Aggregate
2. T27, Sieve Analysis of Fine and Coarse Aggregates.

B. American Society for Testing and Materials (ASTM).

1. D1557, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³)).

C. This specification includes by reference, requirements of additional specifications as listed. The Contractor shall perform the Work in accordance with requirements of the referenced specification in addition to the requirements of this Section.

1. Materials and construction methods shall conform, insofar as applicable, to the requirements of the **Standard Specifications for Highways and Bridges of the Massachusetts Highway Department of the Commonwealth of Massachusetts, dated 1988**, herein after referred to as the MHD Standard Specification, together with all errata addenda additional revisions, and supplemental specifications.

1.03 DEFINITIONS

- A. The term Screened Gravel as used in these Contract Documents shall mean Crushed Stone.

1.04 SUBMITTALS

A. Shop Drawings

- 1. Provide proctor analysis and sieve analysis when gradation requirements are given in the Specification.

B. Samples

- 1. Furnish representative sample including location of source with Shop Drawing transmittal sheet.

1.05 QUALITY ASSURANCE

A. Field Samples

- 1. All materials furnished by the Contractor to be incorporated into the Work shall be subject to the inspection of the Engineer. The Engineer shall be the sole judge as to the acceptability of proposed materials and said judgement shall be final, conclusive, and binding.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Storage and Protection

- 1. In accordance with General Conditions.

PART 2 PRODUCTS

2.01 MATERIALS

A. Crushed Stone

- 1. For bedding and pipe zone material for pipe larger than 3 inches diameter. Well graded in size from 3/8 inches to 3/4 inches or such other sizes as may be approved.
- 2. For bedding and pipe zone material for plastic pipe 3 inches diameter and less, maximum particle size shall be 3/8 inches.
- 3. Clean, hard, and durable particles or fragments, free from dirt, vegetation, or other objectionable matter, and free from an excess of soft, thin elongated, laminated or disintegrated pieces.

4. Screened Stone of similar size and grading to this specification may be used instead of Crushed Stone.

B. Gravel Borrow

1. Granular material well graded from fine to coarse with a maximum size, obtained from approved natural deposits and unprocessed except for the removal of unacceptable material and stones larger than the maximum size permitted.
2. Gravel shall not contain vegetation, masses of roots, or individual roots more than 18 inches long or more than 1/2 inches in diameter.
3. Gravel shall be substantially free from loam and other organic matter, clay and other fine or harmful substances.
4. Gradation requirements for gravel shall be in accordance with MHD Standard Specification Section M1.03.0, Type as detailed on the Drawings.

C. Select Borrow

1. Use inorganic natural soils and/or rock having not more than 5 percent by weight passing the No. 200 sieve and having a maximum 3 inch stone size.
2. Use only material well-graded throughout entire site range, free from roots, leaves and other organic materials, free of ice or frost and aggregations of frozen soil particles.
3. Control the moisture content of borrow within plus or minus 3 percent optimum moisture content at the borrow source.

D. Gravel Base Course

1. In accordance with SECTION 02500.

2.02 SOURCE QUALITY CONTROL

A. Test, Inspection

1. Engineer may elect to sample material supplied at the source.
2. Assist the Engineer and/or personnel from the designated testing laboratory in obtaining samples.

PART 3 EXECUTION

3.01 INSTALLATION

A. Crushed Stone

1. Spread in layers of uniform thickness not greater than 6 inches.

2. Compact thoroughly by means of a suitable vibrator or mechanical tamper.

B. Gravel Borrow

1. Spread in layers of uniform thickness not exceeding 12 inches before compaction and moistened or allowed to dry as directed.
2. Compact thoroughly by means of suitable power-driven tampers or other power-driven equipment.
3. Compaction shall conform to 95% of minimum dry density per ASTM D 1557.
4. The percolation rate for the compacted bank-run gravel shall not exceed 5 minutes per inch.

C. Select Borrow

1. Spread in layers of uniform thickness not exceeding 12 in. before compaction and moistened or allowed to dry.
2. Compact thoroughly by means of suitable power-driven tampers or other power-driven equipment unless otherwise directed by the Engineer.

3.02 FIELD QUALITY CONTROL

A. Site Tests

1. In accordance with SECTION 01410.

END OF SECTION

SECTION 02272

GEOTEXTILE MATERIALS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes

1. Requirements for installation of geotextile filter fabric in trenches and under riprap.

B. Related Sections

1. Section 02100 - Site Preparation
2. Section 02200 – Earthwork
3. Section 02215 – Aggregate Materials

1.02 REFERENCES

A. American Society for Testing and Materials (ASTM)

1. D3786, Test Method for Hydraulic Bursting Strength of Knitted Goods and Nonwoven Fabrics: Diaphragm Bursting Strength Tester Method
2. D4355, Test Method for Deterioration of Geotextiles From Exposure to Ultraviolet Light and Water (Xenon-Arc Type Apparatus)
3. D4491, Test Method for Water Permeability of Geotextiles by Permittivity
4. D4533, Test Method for Trapezoid Tearing Strength of Geotextiles
5. D4632, Test Method for Grab Breaking Load and Elongation of Geotextiles
6. D4751, Test Method for Determining Apparent Opening Size of a Geotextile
7. D4833, Test Method for Index Puncture Resistance of Geotextiles, Geomembranes and Related Products
8. D5261, Measuring Mass Per Unit Area of Geotextiles.

1.03 QUALITY ASSURANCE

A. General

1. Producer of fabric to maintain competent laboratory at point of manufacture to insure quality control in accordance with ASTM testing procedures.
2. Laboratory to maintain records of quality control results.

1.04 SUBMITTALS

A. Shop Drawings

1. Submit in accordance with SECTION 01300
2. Include manufacturer's recommended method of joining of adjacent fabric panels.

B. Certificate of Conformance

1. Upon each shipment/delivery of product to the work site, furnish mill certificate(s) from the company manufacturing the fabric attesting that the fabric meets the chemical, physical, manufacturing and performance requirements specified. Fabric will be rejected if it is found to have defects, rips, flaws, deterioration or other damage.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Provide fabric in rolls wrapped with a heavy-duty protective covering to protect fabric from, mud, dirt, dust, debris and other deleterious sources until it is installed. Label each roll of fabric with number or symbol to identify production run.
- B. Do not expose fabric to ultraviolet radiation (sunlight) for more than 20 days total in period of time following manufacture until fabric is installed and covered.
- C. If Engineer determines material is damaged in any way or has excessive sunlight exposure, the Contractor shall immediately make all repairs and replacements as directed by the Engineer, at no additional cost to the Owner.

1.06 SCHEDULING

- A. Schedule Work so that the covering of the fabric with a layer of the cover material is accomplished immediately after inspection and approval of the placed fabric by the Engineer. Failure to comply with this requirement shall require replacement of the fabric.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURER/MATERIAL

- A. The geotextile fabric shall be nonwoven polypropylene designated as MIRAFI 140N as manufactured by Nicolon/Mirafi Group, Norcross, Georgia; or acceptable equivalent and shall meet the following minimum requirements:

<u>Minimum Property (Unit)</u>	<u>Unit</u>	<u>Test Method</u>	<u>Requirements</u>
Weight	oz/sy	ASTM D5261	4.3
Grab Tensile Strength	lbs	ASTM D4632	120
Grab Tensile Elongation	%	ASTM D4632	50
Mullen Burst Strength	psi	ASTM D3786	240
Puncture Resistance	lbs	ASTM D4833	70
Trapezoid Tear Strength	lbs	ASTM D4533	50
Equivalent Opening Size (EOS)	US Std. Sieve (mm)	ASTM D4751	70 (0.21)
Permittivity	sec ⁻¹	ASTM D4491	1.5
Permeability	cm/sec	ASTM D4491	0.22
Flow Rate	gal/min/sf	ASTM D4491	120
Ultraviolet Resistance (strength retained at 500 hrs)	%	ASTM D4355	70

- B. To keep the number of overlay joints to a minimum, fabric shall be provided in sections not less than fifteen (15) feet in width unless otherwise approved by the Engineer prior to delivery to the site.

PART 3 EXECUTION

3.01 SUBGRADE PREPARATION

A. For Riprap

1. Prepared areas to receive geotextile in accordance with SECTION 02100 and SECTION 02200
2. Clear subgrade of all sharp objects, large stones, roots, debris, or any other foreign materials that may contribute to puncturing, shearing, rupturing or tearing of the geotextile.
3. Grade area as smooth as possible and compact in accordance with SECTION 02200, with a vibratory roller or other method approved by the Engineer.
4. Inspect subgrade and repair all unstable areas or soft spots with the installation of gravel and recompact prior to the placement of geotextile.

3.02 FABRIC INSTALLATION

A. For Riprap

1. Place at the locations shown on the Contract Drawings.
2. Unroll directly onto the prepared slope in a continuous manner. Join adjacent sections by overlapping the fabric a minimum of 12-inches. Join end sections by

overlapping the fabric a minimum of 2-feet with field-sewn joints or as recommended by the manufacturer.

3. Place fabric on slopes creating a “shingled” effect in the direction of anticipated water flow.
4. Lay fabric smooth, maximizing surface contact with the prepared subbase, free of tension, stress, folds, wrinkles, or creases.
5. Securely anchor fabric sections at the top of the slope as recommended by the manufacturer. Use anchoring pins, nails, staples or other such means to secure fabric to the subbase surface to prevent fabric movement caused by wind uplift, and/or placement of cover material.
6. Maintain sufficient amount of cover material (minimum depth of 6-inches) to protect fabric during placement of riprap. Dozer buckets or blades, or other heavy or damaging equipment shall not be in direct contact with the fabric.
7. Minimize the height from which cover material is dumped and/or dropped directly onto the fabric material in order to avoid fabric damage or movement. Equipment used for spreading and compacting the cover material shall be of the type and size to avoid damage or movement to the underlying geotextile fabric.
8. Spread cover material in the direction of fabric overlap and in a manner that avoids creating undue tension, stress, sagging, buckling and/or other movement of the underlying fabric.

B. Fabric Installation in Trenches

1. In accordance with manufacturers recommendations
2. Place fabric in trench prior to placing crushed stone pipe bedding.
3. Overlap fabric 18-inches minimum for unsewn lap joints.
4. Do not permit equipment to travel directly on fabric.
5. Place fabric in smooth condition to prevent tearing or puncture.
6. Lay fabric loosely, without wrinkles or creases.
7. Leave slack in fabric to allow for adjustment.

3.03 PROTECTION

- A. Protect the work before, during and after installation, and protect the installed work covered by other Sections.

3.04 REPAIR

- A. Geotextile fabric damaged during installation shall be repaired by a piece of geotextile material cut, placed and adequately anchored over the damaged area, subject to a 3-foot minimum overlap requirement or as directed by the Engineer.

- B. If detrimental movement of the geotextile fabric occurs during any step of the installation, as determined solely by the Engineer, the Contractor shall remove the cover material and/or sections of fabric to the limits deemed necessary and reinstall the fabric.
- C. Any fabric damage during its installation or during placement of cover materials shall be replaced by the Contractor at no additional cost to the Owner.

END OF SECTION

SECTION 02500

PAVEMENT

GENERAL

1.01 SUMMARY

A. Section Includes

1. Requirements for construction of all temporary and permanent pavement on paved areas affected or damaged by his operations, whether inside or outside the normal trench limits, as indicated on the drawings and as herein specified.

B. Related Sections

1. Section 02200 - Earth Excavation, Backfill, Fill and Grading

1.02 REFERENCES

- A. 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 pavements.

1. Standard Specifications for Highways and Bridges of the Highway Department of the Commonwealth of Massachusetts, dated 1988, together with all errata addenda additional revisions, and supplemental specifications, all of which are hereinafter referred to as the MHD Standard Specifications.

1.03 PAVEMENT SCHEDULE

- A. The Contractors attention is directed to the various pavements required under this contract, and their locations as detailed below.

- B. All pavement thickness specified in this specification shall be of the thickness required after compaction.

1.

<u>Location:</u>	<u>Site Driveway</u>
Type:	Flexible
Requirements:	Min. 12" Gravel Base Course Thickness as indicated in Details

PRODUCTS

2.01 MATERIALS

A. Asphalt Tack

1. Tack coat shall consist of emulsified asphalt, grade RS-1 or cutback asphalt, Conforming to the requirements of the MHD Standard Specification Section M3.11.06.

B. Bituminous Base

2. Bituminous Base shall conform to the requirements of the MHD Standard Specification Section 420 and M3.11.00 for Base Course.

C. Bituminous Binder Trench Width (Permanent Pavement)

1. Bituminous Binder Course shall conform to the requirements of the MHD Standard Specification Section 420 and M3.11.00 for Binder Course.

D. Bituminous Surface, Trench Width (Permanent Pavement)

1. Bituminous Surface Course shall conform to the requirements of the MHD Standard Specification Section 460 and M3.11.00 for surface course Class I-1.

E. Bituminous Surface, Curb to Curb (Not Used)

1. Bituminous Surface Course shall conform to the requirements of the MHD Standard Specification Section 460 and M3.11.00 for surface course Class I-1.

F. Reinforced Concrete Base (Not Used)

1. Concrete Base shall conform to the requirements of the MHD Standard Specification, Section 430.

G. Bituminous Binder (Temporary Pavement)

1. Temporary Pavement shall be Binder Course conforming to the requirements of the MHD Standard Specification Section 420 and M3.11.00 for Binder Course.

H. Dense-Graded Crushed Stone Base Course (Temporary and Permanent)

1. The dense graded crushed stone base course shall consist of coarse aggregates of crushed stone or gravel and fine aggregates of natural sand or stone screenings. Uniformly pre-mixed with a predetermined quantity of water and placed on the sub-base in close conformity with the lines and grades shown on the contract plans or established by the Engineer.

2. Coarse aggregate shall consist of hard, durable particles or fragments of stone. Materials that break up when alternately frozen and thawed or wetted and dried shall not be used.
3. Coarse aggregate shall have a percentage of wear, by the Los Angeles Abrasion Test (AASTO-T-96) of not more than 45.
4. Fine aggregate shall consist of natural or processed sand.
5. The composite material shall be free from clay, loam or other cohesive soil, and shall conform to the following grading requirements:

Sieve Designation Mesh Sieves	Percentage by Weight Passing Square
2 in.	100
1-1/2 in.	70-100
3/4 in.	50-85
No. 4	30-55
No. 50	8-24
No. 200	3-10

6. Sampling and testing shall be in accordance with the following standard AASHTO methods:

Sieve Analysis	T27
Passing No. 200 Sieve	T11

7. The gravel base course shall be spread and compacted in one layer, 4 inches in compacted depth, to the same tolerances specified above for the gravel sub-base.
8. The gravel base course material shall meet the same requirements as specified in MHD Specification M2.01.7 except as noted above.

I. Gravel Base Course

1. The gravel base course shall consist of Gravel Borrow Type C, as specified in MHD Standard Specification Section M1.03.0
2. The gravel base shall be spread and compacted in layers not exceeding 8 inches in depth compacted measurement, to not less than 95 percent of the maximum dry density of the material, as determined by the Standard AASHTO Test Designation T99 compaction test Method C within 5% of optimum moisture content as determined by the Engineer. If the material retained on the #4 sieve is 50% or more of the total sample, this test shall not apply and the material shall be compacted to the satisfaction of the Engineer. The specific density of the Gravel Base shall be maintained by determining the number of passes of a roller required to produce a constant and uniform density, after conducting a series of tests either using the sand/volume or the nuclear density-testing device.

3. Any stone with a dimension greater than 2 inches shall be removed from the base before the gravel is compacted. Compaction shall continue until the surface is even and true to the proposed lines and grades within a tolerance of ½-inch above or below the required cross sectional elevations and to a maximum irregularity not exceeding ½ inch under a 10 foot line longitudinally. Any specific area a gravel base which, after being rolled, does not form a satisfactory, solid, stable foundation shall be removed, replaced and recompactd by the Contractor without additional compensation.

2.02 SOURCE QUALITY CONTROL

- A. The paving plant used by the Contractor for preparation of bituminous paving materials shall be acceptable to the Engineer who shall have the right to inspect the plant and the making of the material as specified in MHD Specification M2.01.7 except as noted above.

EXECUTION

3.01 PREPARATION

- A. Prior to placing pavement, all backfill shall have been properly compacted as specified under Section 02200 to eliminate settling of backfill. No pavement shall be placed over poorly compacted backfill. Backfill and gravel base course shall be compacted, brought to the proper elevation, and dressed so that new pavement construction shall be at the required grade. The Contractor shall maintain the surfaces of all excavated and disturbed areas until the pavement is placed. If there is a time lapse of more than 24 hours between completion of preparation of subgrade or placing of gravel base course and placing of paving, or if subgrade or gravel base course has been eroded or disturbed by traffic, the subgrade or gravel base course shall be restored before placing pavement.
- B. When installing permanent pavement on bituminous concrete roadway the edges of existing pavement shall be cut with a saw from the trench excavation wall or damaged area to sound undamaged material, straightened, cleaned, and painted with an accepted asphalt emulsion to ensure a satisfactory bond between it and the newly placed surface courses. Existing surface courses shall be stripped from the bituminous concrete base course for at least a 6-inch width and trimmed square and straight so that new permanent surfacing shall be placed on undisturbed bituminous concrete base course. Existing pavement shall be swept clean prior to placing any asphalt emulsion over it. Existing pavement that will be under new pavement shall be painted with asphalt emulsion to ensure a satisfactory bond.
- C. Before permanent pavement is installed, the base shall be brought to the proper grade, and temporary pavement and excess gravel base shall be removed.

- D. All manhole covers, catch basin grates, valve and meter boxes, curbs, walks, walls and fences shall be adequately protected and left in a clean condition. Where required, the grades of manhole covers, catch basin grates, valve boxes, and other similar items shall be adjusted to conform to the finished pavement grade.
- E. The Contractor shall remove and acceptably dispose of all surplus and unsuitable material.

3.02 INSTALLATION

A. General

1. Unless indicated otherwise, all permanent bituminous pavement shall be installed in two courses or more. Bituminous base courses shall be carefully spread and raked to a uniform surface and thoroughly rolled before application of the top course.
2. All top courses of permanent paving shall be applied with acceptable mechanical spreaders in widths of at least 9 feet.
3. The rolling for all bituminous and gravel base courses shall conform to the standards listed in the appropriate Subsection of the Standard Specification.
4. Pavement shall be placed so that the entire roadway or paved area shall have a true and uniform surface, and the pavement shall conform to the proper grade and cross section with a smooth transition to existing pavement.
5. Keyways shall be cut into existing pavement where all new pavement abuts existing pavement including driveways.

B. Gravel Base Course

1. The dense graded crushed stone base course shall be placed to such depth that the furnished compacted base course is the depth as indicated on the drawings and specified herein.
2. The top of the dense graded crushed stone base course shall be below the furnish grade a distance required to accommodate the compacted pavement material as indicated on the drawings and specified herein.
3. The gravel base as herein specified shall be 12-inches thick for flexible pavement and 6-inches thick for rigid pavement.

C. Temporary Pavement:

1. Temporary pavement shall be placed over all trenches in paved areas where directed by the Engineer.
2. The Contractor, upon completing the backfilling and compaction of the trenches in the streets and the placing of the gravel base courses, shall be required to construct temporary pavement unless otherwise directed by the Engineer.

3. Temporary Pavement in Town or City roads shall be placed in one course and shall consist of 2-inch compacted thickness of hot bituminous mix, on a 12-inch compacted thickness gravel base as directed by the Engineer.
4. The Contractor shall maintain temporary pavement in good repair and flush with the existing pavement at all times until the permanent pavement is placed.
5. The temporary pavement shall not be removed until 60 days after installation or until such time that the Engineer authorizes the placement of permanent pavement at an earlier time.

D. Bituminous Base:

1. Bituminous Base shall be used in streets and parking areas as listed in Article 1.03 of this specification.
2. Bituminous Base shall be placed to the thickness as indicated in Article 1.03 of this Specification and installed in accordance with the requirements of the MHD Standard Specification and as detailed in the Contract Drawings.
3. Prior to placing bituminous base, all temporary pavement and sufficient gravel base course shall be removed, to proper depths as detailed in the contract drawings.

E. Reinforced Concrete Base: (Not Used)

1. Reinforced Concrete Base shall be used in the streets as listed in Article 1.03 of this specification.
2. Reinforced Concrete Base shall be 8-inch thick and installed in accordance with the requirements of the MHD Standard Specification.
3. Prior to placing reinforced concrete base, all temporary pavement and sufficient gravel base course shall be removed, to proper depths as detailed in the contract drawings.

F. Bituminous Binder

1. Bituminous Binder shall be used in the streets as listed in Article 1.03 of this specification.
2. Bituminous Binder shall be placed to the thickness as indicated in Article 1.03 of this Specification and installed in accordance with the requirements of the MHD Standard Specification and as detailed in the Contract Drawings.

G. Bituminous Surface

1. Bituminous Surface shall be used in the streets as listed in Article 1.03 of this specification.

2. Bituminous Surface shall be placed to the thickness as indicated in Article 1.03 of this Specification and installed in accordance with the requirements of the MHD Standard Specification and as detailed in the Contract Drawings.

H. Sidewalks, Driveways, Parking Lots and Curbing

1. Sidewalks, driveways, parking lots and curbing that are removed or damaged by the Contractor's operations shall be restored to a condition at least equal to that in which they are found immediately prior to the start of operations. Materials and methods used for such restoration shall be in conformance with the requirements of the MHD Standard Specification.
2. Where the trench location is in a sidewalk, the entire width of the sidewalk shall be replaced with new material. Side forms shall be set so as to obtain and preserve a straight edge along both sides of the walk.
3. Where trench is in a driveway, the driveway shall be repaved across its entire width with even edges.
4. Entire driveway and parking lot shall be repaved in accordance with Article 1.03 of this section.
5. Gravel base course under sidewalks and driveways shall not be less than 12" inch thick.

I. Surface Maintenance

1. During the guarantee, period, the Contractor shall maintain the bituminous surface and shall promptly make good all defects such as cracks, depressions, and holes that may occur. At all times, the surfacing shall be kept in a safe and satisfactory condition for traffic. If defects occur in surfacing constructed by the Contractor, the Contractor shall remove all bituminous concrete and base course as is necessary to properly correct the defect. After removing bituminous concrete and base course, the Contractor shall correct the cause of the defect and replace the base course and bituminous concrete in accordance with these specifications.

J. Bituminous Concrete Excavation by Cold Planer

1. The cold planer shall be at least 72 inches wide and capable of a 3-inch cut to a predetermined grade or any specified lesser depth in one pass.
2. The cold planer shall be capable of planing both bituminous pavements and cement concrete patches if the latter are found in bituminous pavements. It shall be self-propelled and have the means for planing without tearing or gouging the underlying surface. Variable lacing patterns shall be provided to permit a rough grooved or smooth surface as directed.
3. The cold planer must be equipped with an elevating device capable of loading planed material directly into dump trucks while operative and with all necessary

safety devices such as flashing lights and back-up signals so as to operate in traffic with complete safety.

4. The cold planer must comply with the standards set by the Air Quality Act for noise and air pollution.
5. Cold planers mounted on pneumatic tires will not be employed except for trimming and clean-up operations.

END OF SECTION

SECTION 02607

PRECAST CONCRETE MANHOLES

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes

1. Requirements for modular precast concrete manhole sections with tongue-and-groove joints, cast iron covers, accessories and appurtenances.
2. **Items in this specification section are subject to the American Iron and Steel requirements of P.L. 113-76, the Consolidated Appropriations Act of 2014.**

B. Related Sections

1. Section 03300 - Cast-In-Place Concrete

1.02 REFERENCES

A. American Society for Testing and Materials (ASTM)

1. A48, Standard Specification for Gray Iron Castings.
2. A615 Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
3. C32, Standard Specification of Sewer and Manhole Brick (Made from Clay or Shale), AASHTO Designation M91-42, Red Sewer Brick Only Grade SS.
4. C144, Standard Specification for Aggregate for Masonry Mortar.
5. C150, Standard Specification for Portland Cement.
6. C207, Standard Specification for Hydrated Lime for Masonry Purposes.
7. C270, Standard Specification for Mortar for unit Masonry
8. C443, Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.
9. C478, Standard Specification for Precast Reinforced Concrete Manhole Sections.
10. C923, Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals.
11. D4101, Standard Specification for Propylene Plastic Injection and Extrusion Materials.

1.03 SYSTEM DESCRIPTION

A. Design Requirements

1. Manholes shall conform in shape, size, dimensions, materials, and other respects to the details indicated in the Contract drawings.
2. All manholes shall have concrete bases. Invert channels shall be formed with brickwork upon the base.
3. Manhole walls (barrels and cones) shall be precast concrete sections. The corbel (not to be more than 12-in.) shall be built of brickwork to permit adjustment of the frame to meet the finished surface.
4. The inverts shall conform accurately to the size of the adjoining pipes. Side inverts shall be curved and main inverts (where direction changes) shall be laid out in smooth curves of the longest possible radius which is tangent, within the manhole, to the centerlines of adjoining pipelines.

1.04 SUBMITTALS

A. Shop Drawings

1. In accordance with Specification SECTION 01300 - SUBMITTALS.

B. Samples

1. Provide representative samples of materials if requested by the Engineer.

PART 2 PRODUCTS

2.01 PRECAST CONCRETE SECTIONS

A. Conform to the ASTM C478 with the following exceptions and additional requirements:

1. All cast in place concrete shall be Class A and shall conform to the requirements specified under SECTION 03300.
2. Wall sections to be 5-inch thick minimum.
3. Type II cement in accordance with ASTM C150.
4. 4.0 feet and 5.0 feet diameter manholes minimum of 4,000 psi - 28 days compressive strength.
5. 6.0 foot diameter manhole minimum of 5,000 psi. - 28 days compressive strength. Except as otherwise permitted.
6. Sections shall be cured by subjecting them to thoroughly saturated steam at a temperature between 100 and 130 degrees F. for a period of not less than 12 hours

or, when necessary for such additional item as may be needed to enable the sections to meet the strength requirements.

7. No more than two lift holes may be cast or drilled in each section.
8. The date of manufacture and the name of trademark of the manufacturer shall be clearly marked on the inside of the barrel.
9. Acceptance of the sections will be on the basis of material tests and inspection of the completed product.

B. Flat Slab Tops

1. Thickness and reinforcement as indicated on the drawings and in accordance with ASTM C-478.

C. Cones

1. Cones shall be precast sections of construction similar to above.

D. Bases

1. The tops of the bases shall be suitably shaped by means of accurate bell-ring forms to receive the barrel sections.
2. All holes for pipes shall be cast in the base sections so that there is a clear distance of four inches minimum between the inside bottom of the base section and the pipe invert.
3. Base pad shall be pre-cast with extended base as indicated on drawings and herein specified.
4. Openings for pipe and materials to be embedded in the wall of the base for these joints shall be cast in the base at the required locations during the manufacture of the base.

2.02 COMPONENTS

A. Pipe Seals

1. Premolded elastomeric-sealed joints fitted or cast integrally into the pipe opening of the manhole base and/or wall section.
2. Provide a watertight joint.
3. Maximum 10-degree omni-directional deflection.
4. Conform to ASTM C-923.
5. Seals to be:
 - a. Lock Joint Flexible Manhole Sleeve made by Interpace Corp., Parsippany, NJ;
 - b. Kor-N-Seal made by National Pollution Control Systems, Inc., Nashua, NH;
 - c. A-LOK manhole pipe seal made by A-LOK Corp., Trenton, NJ;

- d. or an acceptable equivalent product.
6. All materials, accessories and construction methods used in making the joints shall be supplied or approved by the manufacturer of the premolded elastomeric-sealed joint. Furnish manufacturer's written instructions to the Engineer.

B. Exterior Coating

1. The material shall be:
 - a. Carboline Bitumastic 300M by Somay Products, Inc., Miami, FL or
 - b. Sonoshield HLM 5000 by Sonoborn, Shakopee, MN or
 - c. Acceptable equivalent product.

C. Rubber Gaskets (between manhole sections)

1. In accordance with ASTM C443.
2. Gasket configuration per manufacturers recommendation.

D. Butyl Resin Gaskets (between manhole sections)

1. In accordance with ASTM C990.
2. Gasket configuration per manufacturer's recommendation.

2.03 ACCESSORIES

A. Manhole Frames and Covers

1. Furnish all cast-iron manhole frames and covers conforming to the details shown on the drawings, or as hereinbefore specified.
2. Castings shall be of good quality, strong, tough, even-grained cast iron, smooth, free from scale, lumps, blisters, sandholes, and defects of every nature which would render them unfit for the service for which they are intended. Contact surfaces of covers and frame seats shall be machined to prevent rocking of covers.
3. Casting shall be thoroughly cleaned and subject to a careful hammer inspection.
4. Castings shall be at least Class 25 conforming to the ASTM A48.
5. Standard sewer manhole frames and covers to have 24 inch clear opening (26 inch diameter covers) and minimum 6 inch high frames, manufactured by East Jordan Iron Works (formerly LeBaron Foundry, Inc.), or approved equal. Pattern of cover and lettering shall comply with the Owner's standards.
6. Watertight sewer manhole frames to have 26 inch diameter covers with 6 stainless steel bolts, and watertight gasket, manufactured by East Jordan Iron Works (formerly LeBaron Foundry, Inc.) or approved equal. Pattern of cover and lettering shall comply with the Owner's standards.

B. Brick

1. Sound, hard, and uniformly burned brick, regular and uniform in shape and size, of compact texture, and satisfactory to the Engineer.
2. In accordance with ASTM C32, Red Sewer Brick Only Grade SM.
3. In accordance with AASHTO M91-42, Red Sewer Brick Only Grade SM.
4. Reject brick shall be immediately removed from the work.

C. Mortar for Brickwork

1. In accordance with ASTM C270.
2. Composed of Portland cement, hydrated lime, and sand in which the volume of sand shall not exceed three times the sum of the volume of cement and lime.
3. The proportions of cement and lime shall be 1:1/4.
4. Cement shall be Type II Portland cement in accordance with Specification SECTION 03300.
5. Hydrated lime shall be Type S conforming to the ASTM C207.
6. Hydrated lime shall be "Mortaseal" manufactured by U.S. Gypsum or
7. "4X Hydrate" manufactured by the New England Lime Company or
8. An acceptable equivalent product.
9. The sand shall conform to ASTM C144.

PART 3 EXECUTION

3.01 INSTALLATION

A. Manhole Sections

1. Set so as to be vertical and with sections in true alignment.
2. All holes in sections used for handling shall be thoroughly plugged with rubber plugs made specifically for this purpose or with mortar. The mortar shall be one part cement to 1-1/2 parts sand, mixed slightly damp to the touch (just short of "balling"), hammered into the holes until it is dense and an excess of paste appears on the surface, and then finished smooth and flush with the adjoining surfaces.

B. Butyl Resin Gaskets (between manhole sections)

1. In accordance with manufacturers recommendation.
2. Install in all joints between precast sections.

C. Brickwork

1. Only clean bricks shall be used.
2. Bricks shall be moistened by suitable means, until they are neither so dry as to absorb water from the mortar nor so wet as to be slippery when laid.
3. Each brick shall be laid in a full bed and joint of mortar without requiring subsequent grouting, flushing, or filling, and shall be thoroughly bonded.
4. All sewer inverts shall be constructed in-place after installation of sewer piping to manhole is complete. The bench shall be even with the crown of the pipe. Above ground construction of manhole inverts is not acceptable.

D. Plastering And Curing Brick Masonry

1. Outside faces of brick masonry adjustment courses shall be plastered with mortar to a thickness of 1/2-inch.
2. If required, the masonry shall be properly moistened prior to application of the mortar.
3. The plaster shall be carefully spread and troweled. After hardening, the plaster shall be carefully checked by being tapped for bond and soundness.
4. Unbonded or unsound plaster shall be removed and replaced.
5. Brick masonry and plaster shall be protected from too rapid drying by the use of burlaps kept moist, or by other suitable means, and shall be protected from the weather and frost, to insure maximum strength.

E. Exterior Coating

1. The exterior surfaces of all manholes shall be given two coats of bituminous waterproofing material totaling a minimum of 14 mils in thickness.
2. The waterproofing material shall be applied by brush or spray and in accordance with the instructions of the manufacturer.
3. Time shall be allowed between coats to permit sufficient drying so that the application of the second coat has no effect on the first coat.

3.02 SETTING MANHOLE FRAMES AND COVERS

- A. Manhole frames shall be set with the tops conforming accurately to the grade of the pavement or finished ground surface or as indicated on the drawings or directed. Frames shall be set concentric with the top of the masonry and in full bed of mortar so that the space between the top of the manhole masonry and the bottom flange of the frame shall be completely filled and made watertight. A thick ring of mortar extending to the outer edge of the masonry shall be placed all around and on the top of the bottom flange. The mortar shall be smoothly finished and have a slight slope to shed water away from the frame.

B. Manhole frames and covers shall be brought to grade with 2 or more, but no more than 5 courses of brick.

C. Manhole covers shall be left in place in the frames on completion of work at the manholes.

3.03 FIELD QUALITY CONTROL

A. Testing

1. Gravity Sewer Manholes shall be vacuum tested in accordance with ASTM C1244 prior to backfilling.
2. Lift holes shall be plugged and pipes entering the manhole shall be temporarily plugged.
3. A vacuum of 10 inches of mercury shall be drawn on the manhole.
4. The manhole shall pass if the time for the vacuum reading to drop from 10 inches of mercury to 9 inches of mercury meets or exceeds the values in the Table below.
5. If the manhole fails the initial test, necessary repairs shall be made by a method approved by the Engineer. The manhole shall then be retested and repairs shall be made until a satisfactory test is obtained.

Table 1 - Minimum Test Times for Various Manhole Diameters

Depth Ft	Diameter (in.)								
	30	33	36	42	48	54	60	66	72
Time (sec)									
8	11	12	14	17	20	23	26	29	33
10	14	15	18	21	25	29	33	36	41
12	17	18	21	25	30	35	39	43	49
14	20	21	25	30	35	41	46	51	57
16	22	24	30	34	40	46	52	58	67
18	25	27	32	38	45	52	59	65	73
20	28	30	35	42	50	53	65	72	81

3.04 CLEANING

A. Manholes to be free of construction debris prior to final inspection.

END OF SECTION

SECTION 02618

DUCTILE-IRON PIPE AND FITTINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Requirements to furnish, lay, joint, and test buried ductile-iron pressure pipe, fittings (including special castings), and appurtenant materials and equipment indicated on the Drawings and specified in this Section.
- B. **Items in this specification section are subject to the American Iron and Steel requirements of P.L. 113-76, the Consolidated Appropriations Act of 2014.**

1.02 REFERENCES

- A. American Water Works Association (AWWA)/American National Standards Institute (ANSI)
 - 1. C105/A21.5, Polyethylene Encasement for Ductile Iron Pipe Systems
 - 2. C111/A21.11, Rubber-Gasket Joints for Ductile-Iron and Pressure Pipe and Fittings.
 - 3. C115/A21.15, Flanged Ductile Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges.
 - 4. C150/A21.50, Thickness Design of Ductile-Iron Pipe.
 - 5. C151/A21.51, Ductile-Iron Pipe, Centrifugally Cast for Water.
 - 6. C153/A21.53, Ductile-Iron Compact Fittings, 3 inches through 24 inches, and 54 inches through 64 inches for Water Service
 - 7. C600, Installation of Ductile-Iron Water Mains and Their Appurtenances
- B. American Society of Testing and Materials (ASTM)
 - 1. A536, Standard Specification for Ductile Iron Castings

1.03 REQUIREMENTS

- A. Ductile iron pipe and fittings used for sewer force mains shall be epoxy lined thickness Class 52 push-on joint, size as indicated on the drawings.
- B. Location of restrained joints shall be based on Thrust Restraint Design for Ductile Iron Pipe (Second Edition), published by Ductile Iron Pipe Research Association.

1.04 SUBMITTALS

- A. In accordance with Article 6.17 of the General Conditions and Section 01300 – Submittals, submit the following:
- B. Shop Drawings
 - 1. Piping layouts in full detail.
 - 2. Location and type of backup block or device to prevent separation.

3. Schedules of all pipe, fittings, special castings, couplings, expansion joints, restrained joints and other appurtenances.

C. Certificates

1. Sworn certificates of shop tests showing compliance with specified standard.

D. Manufacturer's Literature

1. Catalog cuts of joints, couplings, harnesses, expansion joints, restrained joints gaskets, fasteners and other accessories.
2. Brochures and technical data of coatings and lining's and proposed method of application.

1.05 QUALITY ASSURANCE

- A. Inspection and Testing at foundry shall be done in accordance with ANSI Standards.
- B. Owner reserves right to inspect and/or test by independent service at manufacturer's plant or elsewhere at his own expense.
- C. Owner reserves the right to perform visual inspection and hammer test prior to installation.

PART 2 PRODUCTS

2.01 PIPE

A. Ductile-Iron Pipe

1. Designed in accordance with AWWA/ANSI C150/ A21.50.
2. Manufactured in accordance with AWWA/ANSI C151/A21.51.
3. Unless otherwise indicated or specified, ductile-iron pipe shall be at least thickness Class 52

B. Pipe For Use With Couplings

1. Pipe for use with sleeve-type couplings shall be as specified above except that the ends shall be plain (without bells or beads) cast or machined at right angles to the axis.

2.02 FITTINGS

A. General

1. Push-on or mechanical-joint fittings shall be all-bell fittings unless otherwise indicated or specified.
2. Compact fittings in accordance with AWWA/ANSI C153/A21.53 and shall have a working pressure rating of 350 psi

B. Nuts and Bolts

1. Ductile Iron or Kor-10 steel T bolts and nuts or approved equal.

C. Nonstandard Fittings

1. Fittings having nonstandard dimensions and cast especially for this project shall be of acceptable design.
2. Manufactured to meet the requirements of these specifications and shall have the same diameter and thickness as standard fittings, but their laying lengths and types of ends shall be determined by their positions in the pipelines and by the particular piping to which they connect.

2.03 ADAPTERS

- A. Where it is necessary to joint pipes of different type, furnish and install the necessary adapters unless solid sleeves are indicated on the drawings or permitted. Adapters shall have ends, conforming to the above specifications for the appropriate type of joint, to receive the adjoining pipe. Adapters joining two classes of pipe may be of the lighter class provided that the annular space in bell-and-spigot type joints will be sufficient for proper jointing.

2.04 JOINTS

A. Push-On and Mechanical

1. In accordance with AWWA/ANSI C111/A21.11.
2. The plain end of push-on pipe shall be factory machined to a true circle and chamfered to facilitate fitting the gasket.
3. Push-on and mechanical-joint pipe and fittings shall be provided with sufficient quantities of accessories conforming to AWWA/ANSI C111/A21.11.
4. At the Contractors option, joints in buried pipelines shall be either push on joints or mechanical joints.

B. Restrained

1. Restraining glands will be required on all fittings.
2. Pipe, fittings and appurtenances for restrained joints shall be in accordance with AWWA/ANSI C153/A21.53 for compact fittings. Only restraining glands which impart multiple wedging action against the pipe increasing its pressure as the pipe pressure increases will be allowed. Flexibility of the joint shall be maintained after burial. Glands shall be manufactured of ductile iron conforming to ASTM A536. Twist off nuts shall be used to insure proper actuating of the restraining device.
3. Mechanical joint restraint shall have a working pressure rating of at least 250 psi.
4. Manufactured by EBAA Iron, Inc., Eastland, Texas, or equal.

C. Gaskets

1. Gaskets shall be of a composition suitable for exposure to the product which the pipe is intended.
2. All ductile iron pipe installed in contaminated areas, as indicated on the plans, or as directed by the Engineer shall have nitrile / Buna-N (NBR) gaskets.

2.05 COUPLINGS

A. Flexible Connections

1. Where flexible connections in the piping are specified or indicated on the drawings, they shall be obtained by the use of sleeve-type couplings, split couplings, or mechanical-joint pipe and/or fittings as herein specified.

B. Cast Sleeve Type Couplings

1. Pressure rating at least equal to that of the pipeline in which they are to be installed.
2. Provide Style 441 manufactured by Smith Blair, Inc., Texarkana, Texas, or approved equal.
3. Provided with galvanized-steel bolts and nuts, unless noted otherwise.
4. All couplings shall be provided with gaskets of a composition suitable for exposure to the liquid within the pipe.
5. All gaskets provided with metallic tips for electrical continuity through joints.

C. Solid Sleeve Couplings

1. Solid sleeve couplings and accessories shall be of a pressure rating at least equal to that of the pipeline in which they are to be installed.
2. Couplings shall be ductile iron with gaskets of a composition suitable for exposure to the liquid within the pipe.

2.06 ACCESSORIES

A. Tapped Connections

1. 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 the listed size in the appropriate table of the Appendix to the above-mentioned ANSI A21.51 based on 3 full threads for cast iron and 2 full threads for ductile iron.
2. Where the size of the connections 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 a 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 permitted by the Engineer.
3. All drilling and tapping of cast-iron pipe shall be done normal to the longitudinal axis of the pipe; fitting 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.

2.07 POLYETHYLENE ENCASEMENT

- A. In accordance with AWWA C105, where soil conditions upon excavation are determined by the engineer to be unsuitable for unwrapped ductile iron pipe, and as indicated on the drawings.

2.08 PIPE INSULATION

A. General

- 1. All pipe installed whereby the depth to the springline of the pipe is 4' below finished grade or less shall be insulated unless otherwise directed by the Engineer.

B. Material

- 1. Insulation shall be cellular glass insulation manufactured in accordance with ASTM C552 as manufactured by Owens-Corning Fiberglass Corp., Dow Chemical Co., Johns-Manville Corp., or approved equal.
- 2. Insulation shall be secured in place with Type 304 S.S. bands, 9" on center (3/8" minimum width x 0.15" minimum thickness) Flaps at longitudinal and butt joints of factory-wrapped (fiberglass fabric wrapping) insulation shall be cemented in place with waterproof cement.
- 3. A fiberated asphalt coating shall be applied to the fiberglass fabric wrapped insulation to a dry thickness of 1/8". Coating shall be Insulmatic's 4010, Cary Insulation Seal, Gilsonmatic, or approved equal.

2.09 FINISHES

A. Lining

- 1. Inside of pipe and fittings shall be coated with Inderon Protecto 401 ceramic epoxy lining in accordance with the manufacturer's requirements.
- 2. All field cuts shall be sealed in the field using Inderon Protecto 401 touch-up in accordance with the manufacturer's requirements.
- 3. If authorized by the Engineer damaged pipe coating shall be repaired in the field using Inderon Protecto 401 touch-up in accordance with the manufacturer's requirements. Any section of pipe with the interior coating damaged beyond repair as identified by the Engineer shall be replaced at no additional cost to the Owner.

B. Coating

- 1. Outside of pipe and fittings shall be coated with the standard bituminous coating conforming to AWWA/ANSI C151/A21.51
- 2. Outside surfaces of castings to be encased in concrete shall not be coated.
- 3. Machined surfaces shall be cleaned and coated with a suitable rust-preventative coating at the shop immediately after being machined.

PART 3 EXECUTION

3.01 HANDLING

A. Pipe and Fittings

1. Every care shall be taken in handling and laying pipe and fittings to avoid damaging the pipe, scratching or marring machined surfaces, and abrasion of the pipe coatings.
2. Any fitting showing a crack and any pipe or fitting which has received a severe blow that may have caused an incipient fracture, even though no such fracture can be seen, shall be marked as rejected and removed at once from the Work.
3. In any pipe showing a distinct crack and in which it is believed there is no incipient fracture beyond the limits of the visible crack, the cracked portions, if so approved, may be cut off by and at the expense of the Contractor before the pipe is laid so that the pipe used is perfectly sound. The cut shall be made in the sound barrel at a point at least 12-inches from the visible limits of the crack.

3.02 CUTTING

A. Pipe

1. Except as otherwise approved, all cutting shall be done with a machine having rolling wheel cutters, knives, or saws adapted to the purpose. Hammer and chisel or so-called wheel span cutters shall not be used to cut pipe. All cut ends shall be examined for possible cracks caused by cutting.
2. Cut ends to be used with push-on joints shall be carefully chamfered to prevent cutting the gasket when the pipe is laid or installed.

3.03 INSTALLATION

A. Pipe and Fittings

1. No defective pipe or fittings shall be laid or placed in the piping, and any piece discovered to be defective after having been laid or placed shall be removed and replaced by a sound and satisfactory piece.
2. Each pipe and fitting shall be cleared of all debris, dirt, etc., before being laid and shall be kept clean until accepted in the complete work.
3. Pipe and fittings shall be laid accurately to the lines and grades indicated on the drawings or required. Care shall be taken to ensure a good alignment both horizontally and vertically.
4. Pipe shall have a firm bearing along its entire length.
5. The deflection of alignment at a joint shall not exceed the appropriate permissible deflection as specified in the tabulation titled PIPE DEFLECTION ALLOWANCES.

PIPE DEFLECTION ALLOWANCES

Maximum permissible deflection, in.*

<u>Size of pipe, in.</u>	<u>push-on joint</u>	<u>Mechanical joint</u>
4	19	31
6	19	27
8	12**	12**

10	12 **	12**
12	12**	12**
14	11	12**
16	11	12**
18	11	11
20	11	11
24	11	9
30	11	9
36	11	8
42	7-1/2	7-1/2
48	7-1/2	7-1/2

*Maximum permissible deflection for 18-ft. lengths; maximum permissible deflections for other lengths shall be in proportion of such lengths to 18 ft.

** Per City of Framingham's Requirements.

6. When mechanical joint, push-on joint or similar pipe is laid, the bell of the pipe shall be cleaned of excess tar or other obstructions and wiped out before the cleaned and prepared spigot of the next pipe is inserted into it. The new pipe shall be shoved firmly into place until properly seated and held securely until the joint has been completed.

B. Castings

1. Castings to be encased in masonry shall be accurately set with the bolt holes, if any, carefully aligned.
2. Immediately prior to being set, castings shall be thoroughly cleaned of all rust, scale and other foreign material.

C. Temporary Plugs

1. At all times when pipe laying is not actually in progress, the open ends of pipe shall be closed by temporary watertight plugs or by other approved means. If water is in the trench when work is resumed, the plug shall not be removed until all danger of water entering the pipe has passed.

D. Appurtenances

1. Valves, fittings and appurtenances shall be set and jointed as indicated on the drawings.

3.04 ASSEMBLING

A. Push-On Joints

1. Make up by inserting the gasket into the groove of the bell and applying a thin film of special nontoxic gasket lubricant uniformly over the inner surface of the gasket which will be in contact with the spigot end of the pipe.
2. The chamfered end of the plain pipe shall be inserted into the gasket and then forced past it until it seats against the bottom of the socket.

B. Bolted Joints

1. Before the pieces are assembled, rust-preventive coatings shall be removed from machined surfaces.

2. Pipe ends, sockets, sleeves, housings, and gaskets shall be thoroughly cleaned and all burrs and other defects shall be carefully smoothed.

C. Mechanical Joints

1. Surfaces against which the gasket will come in contact shall be thoroughly brushed with a wire brush prior to assembly of the joint. The gasket shall be cleaned. The gasket, bell, and spigot shall be lubricated by being washed with soapy water.
2. The gland and gasket, in that order, shall be slipped over the spigot, and the spigot shall be inserted into the bell until it is correctly seated.
3. The gasket shall then be seated evenly in the bell at all points, centering the spigot, and the gland shall be pressed firmly against the gasket.
4. After all bolts have been inserted and the nuts have been made up finger tight, diametrically opposite nuts shall be progressively and uniformly tightened all around the joint to the proper tension, preferably by means of a torque wrench.
5. The correct range of torque as indicated by a torque wrench and the length wrench (if not a torque wrench) used by an average man to produce such range of torque, shall not exceed the values specified in the tabulation titled TORQUE RANGE VALUES.

TORQUE RANGE VALUES

Nominal pipe size, <u>in.in.</u>	Bolt diameter, <u>ft.-lb.</u>	Range of torque, <u>in.</u>	Length of wrench,
3	5/8	40-60	8
4 thru 24	3/4	60-90	10
30, 36	1	70-100	12
42, 48	1-1/4	90-120	14

If the effective sealing of the joint is not attained at the maximum torque indicated above, the joint shall be disassembled and thoroughly cleaned, then reassembled. Bolts shall not be over stressed to tighten a leaking joint.

D. Restrained Joints

1. Install in accordance with manufacturers written instructions.
2. Do not exceed manufacturer's permissible pipe deflection allowance.

E. Sleeve-Type Couplings

1. Prior to the installation of sleeve-type couplings, the pipe ends shall be cleaned thoroughly for a distance of 8-inches
2. Soapy water may be used as a gasket lubricant.
3. A follower and gasket, in that order, shall be slipped over each pipe to a distance of about 6-inches from the end, and the middle ring shall be placed on the already laid pipe end until it is properly centered over the joint.
4. The other pipe end shall be inserted into the middle ring and brought to proper position in relation to the pipe already laid.
5. The gaskets and followers shall then be pressed evenly and firmly into the middle ring flares.
6. After the bolts have been inserted and all nuts have been made up finger tight, diametrically opposite nuts shall be progressively and uniformly tightened all

around the joint, preferably by use of a torque wrench of the appropriate size and torque for the bolts. The correct torque as indicated by a torque wrench shall not exceed the manufacturers recommended values.

7. After assembly and inspection and before being backfield, all exterior surfaces of buried sleeve-type couplings, including the middle and follower rings, bolts, and nuts, shall be thoroughly coated with an approved heavy-bodied bituminous mastic. Care shall be taken and appropriate devices used to ensure that the undersides, as well as the more readily accessible parts, are well coated.

3.05 POLYETHYLENE ENCASEMENT

- A. When required, install in accordance with AWWA C105.

3.06 SOCKET PIPE CLAMPS, TIE RODS AND BRIDLES

- A. Where indicated or necessary to prevent joints or sleeve couplings from pulling apart under pressure, suitable pipe clamps, tie rods or bridles shall be provided. Bridles and tie rods shall be at least 3/4 in. diameter except where they replace flange bolts of smaller size, in which case they shall be fitted with a nut on each side of the pair of flanges. The socket clamps, tie rods or bridles shall be coated with an approved bituminous paint after assembly or if necessary, prior to assembly.

3.07 THRUST BLOCKS

- A. Where shown or required, bends, tees, and other fittings in pipelines buried in the ground may be backed up with Class B concrete placed against undisturbed earth where firm support can be obtained. Thrust blocks shall be constructed in accordance with details in the Contract Documents. If the soil does not provide firm support, then restraining devices shall be provided.

3.08 CLEANING

- A. Prior to the pressure and leakage tests, thoroughly clean piping of all dirt, dust, oil, grease and other foreign material. This work shall be done with care to avoid damage to linings and coatings.

3.09 TESTING

- A. In accordance with Specification Section 02704 – Pipeline Pressure and Leakage Testing

3.10 POST CONSTRUCTION WALK-THROUGH

- A. Following activation of the new water main, the Contractor shall participate in a “walk through” of the project with the Owner and/or Engineer to ensure that all valves affected as a result of the project are open and operational.

3.11 CONNECTIONS TO EXISTING FORCE MAINS

- A. In general, no connection to existing force mains will be allowed prior to the new force main successfully passing pressure testing that can be verified with written confirmation. Any exception to this requirement will be at the sole discretion of the Engineer and/or Owner.

END OF SECTION

SECTION 02619

VALVES AND FITTINGS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes

1. Requirements to furnish and install buried valves, and miscellaneous piping appurtenances, as indicated on the Drawings and as herein specified.
2. The Drawings and Specifications direct attention to certain features of the equipment, but do not purport to cover all the details of their design. The equipment furnished shall be designed and constructed equal to the high quality equipment manufactured by such firms as are mentioned hereinafter, or as permitted by the Engineer. The Contractor shall furnish and install the equipment complete in all details and ready for operation.

B. Items in this specification section are subject to the American Iron and Steel requirements of P.L. 113-76, the Consolidated Appropriations Act of 2014

C. Related Sections

1. Section 02215 - Aggregate Materials
2. Section 02200- Earth Excavation, Backfill, Fill and Grading
3. Section 02618 - Ductile Iron Pipe and Fittings
4. Section 03300 - Cast-in-Place Concrete

1.02 REFERENCES

A. American Society for Testing and Materials (ASTM)

1. A48, Standard Specification for Gray Iron Castings
2. A536, Standard Specification for Ductile Iron Castings

B. American Water Works Association (AWWA)/American National Standards Institute (ANSI)

1. Pipe size 4 to 12 inches diameter, push-on joint, pressure Class 350, ANSI/AWWA C150/A21.50, inside epoxy coating per manufacturer standard.
2. Pipe size 12 to 24 inches diameter, push-on joint, pressure Class 250, ANSI/AWWA, C150/A21.50, inside epoxy coating per manufacturer standard

3. ANSI/AWWA C515, Resilient-Seated Gate Valves for Water-Supply Service
4. AWWA C550, Protective Epoxy Interior Coatings for Valves and Hydrants
5. Gaskets shall conform to ANSI/AWWA C111/A21.11
6. Exterior coating of asphaltic material per ANSI/AWWA C153/A21.53 and ANSI/AWWA C110/A21.10.

1.03 SUBMITTALS

A. Submit in accordance with Section 01300 – Submittals

1. Manufacturer's specifications, catalog data, descriptive matter, illustrations, diagrams etc.
2. Operating instructions and parts list.

1.04 QUALITY ASSURANCE

A. Contractor is responsible for verifying outside diameter of pipe to be tapped.

- ##### B. Coatings in contact with water, which is contiguous with any part of municipal water system, are suitable for use in contact with potable water, provided governing authorities approve and harmful chemicals, taste or odor is not imparted to water when cured.

PART 2 PRODUCTS

2.01 RESILIENT SEAT GATE VALVES

- ##### A. Manufactured by American Flow Control, Birmingham AL; Kennedy Valve, Elmira, N.Y. or acceptable equivalent.

B. General

1. Gates shall conform to all applicable sections of AWWA C509.
2. Valve bodies shall be manufactured of ductile iron.
3. Gate valves shall be open **LEFT** (counter clockwise).
4. All valves shall be allowed upper replacement of upper "O" rings while the valve is under pressure in a fully-opened position.
5. Exterior surfaces of all valves shall be coated with a minimum of three applications of an approved bituminous solution, on a rust-free casting, prior to shipment. Valve interiors shall have a two-part thermostat epoxy-protective coating system and meet all requirements of AWWA C550. The epoxy coating shall not impart taste or odors to the water. The coating shall be a product

acceptable to the NSF for use in potable water and shall be so listed in the most current NSF summary of approved products (ANSI/NSF Standard 61). The coating shall be applied and cured in strict conformance with the coating manufacturer's cautions and instructions. The coating shall be applied by the valve manufacturer under controlled factory conditions, and field application is strictly prohibited.

C. All valves shall be designed for 250 psi working water pressure.

D. Buried Valves:

1. Buried valves shall be of the inside-screw type with mechanical-joint ends. An operating nut and extension stem shall be in lieu of hand wheel.
2. The Contractor shall provide the gate boxes and 2-in. square operating nut at the upper end with coupling connected to the valve stem as required.

2.02 BUTTERFLY VALVES

A. Manufactured by Mueller Co., Decatur, IL; H. Pratt Co., Aurora, Ill., Clow Valve Co., Oskaloosa, IA, or acceptable equivalent.

B. Valve Provisions:

1. Valves shall conform to the requirements as specified in the AWWA Standard for Rubber-Seated Butterfly Valves AWWA C504, except as modified or supplemented herein.
2. The valve design shall utilize a continuous rubber lining on the internal body surfaces and extending over the flanges. A disk which seats at an angle to the axis of the pipe will not be acceptable.
3. Mechanical-joint-end type valves shall be utilized, and shall be constructed of ASTM A536, grade 65-45-12 ductile iron.
4. Valves shall be designed for 250 psi working pressure.
5. Butterfly valves shall be open **LEFT** (counter clockwise).
6. The number of turns will be determined by the Owner.

C. The valve shall utilize body mechanical joint ends in accordance with AN Standard of Rubber Gasket Joints for Cast Iron and Ductile Iron pressure pipe and fittings (A21.11).

D. Seat Provisions:

1. The valve shall utilize a molded natural rubber or synthetic rubber seat on the disk or in the body, and be mechanically fastened, not penetrated by the shaft. Type 316 stainless steel shall be utilized in the mating-seat. The seat shall be

replaceable on 12-in. through 24-in. without removing the disk. It shall be mounted securely for complete immobility under operating conditions.

2. If the seat is on the disk, use a Class 40 cast iron disk conforming to ASTM A48, or a Grade 60-40-18 ductile iron conforming to ASTM A536.
 3. If the seat is on the body, use a Class 40 cast iron disk conforming to ASTM A48, or a Grade 60-40-18 ductile iron conforming to ASTM A536, with a Type 316 stainless-steel seating edge, or all Type 316 stainless steel. The stainless-steel edge on cast iron or ductile iron disks shall be either mechanically secured or heat shrunk to the edge of the disk or welded overlay.
- E. Disk Provisions: The disk shall rotate 90 degrees from full open to full close position.
- F. Shaft Provisions: The shaft shall be manufactured from either Type 304 or Type 316 stainless steel. It must be a one-piece unit extended completely through the valve disk.
- G. Miscellaneous Provisions: Type 304 stainless steel, taper pins, lock washers and nuts shall be utilized. The packing gland shaft seal shall be a one-piece cast-iron gland follower with bronze nuts. It shall be self-adjusting, split V-type, packing.
- H. Valve Operator Provisions: Buried valves shall be provided with gate boxes and operating wrenches as hereinafter specified. Where necessary, valves shall be furnished with steel extension stems or universal joint operating rods with 2-in. square operating nuts at the upper end and a suitable coupling to connect to the valve stem.
- I. Buried or Submerged Service Provisions: Valves shall have permanent chevron "V" type packing requiring no adjustment, with self-compensating and self-adjusting seals, under pressure, for buried and submerged service.

2.03 VALVE BOXES

A. Provisions:

1. Valve boxes shall be Buffalo or Erie style, telescoping, heavy pattern type with the lower part manufactured of cast iron and the upper part of steel or cast iron. The valve box shall be designed and constructed to prevent direct transmission of traffic loads to the pipe or valve. Boxes shall be adjustable through at least 6-in. vertically without reduction of lap between sections to less than 4-in. inside diameter of boxes for valves at least 4-1/2 in. and at least 3-in. for stops, and lengths as necessary for depths of the valves or stops with which the boxes are to be used. The top of the cover shall be flush with the top of the box rim. The cover shall have the words "FRAMINGHAM SEWER DEPARTMENT" cast into the top for all gates.

2.04 T-HANDLE OPERATING WRENCHES

- A. Provisions: A T-handle operating wrenches shall be provided in the number and lengths required, but not exceeding 8-ft., to permit operation of all valves and stops by operators of average height working in normal positions.

PART 3 EXECUTION

3.01 VALVES

- A. Erect and support valves in respective positions free from distortion and strain on appurtenances during handling and installation. Inspect the material for defects in workmanship and material. Clean out debris and foreign material from valve openings and seats, test-operating mechanisms to check proper functioning, and check nuts and bolts for tightness. Repair, at no additional compensation, valves and other equipment that do not operate easily or are otherwise defective.
- B. Appropriate blocking shall be placed under each valve to insure against settlement. Blocking with wood is not acceptable.
- C. Valves installed with stems below the horizontal will not be allowed.
- D. Set plumb and support valves adequately in conformance with instructions of manufacturer.
- E. Provide valves with extension stems where required for convenience of operation. Provide extension stems for valves installed underground and elsewhere so that the operating wrench does not exceed 8 ft. in length.
- F. Conduct a final walk through with Owner and Engineer to ensure that all valves are open unless otherwise noted on the contract drawings or directed by the engineer.

3.02 VALVE BOXES

- A. Provide a valve box for each buried stop and valve. Install as detailed on the Drawings

3.03 PAINTING

- A. Touch-up abraded areas of shop coat with paint of the same type as shop coat, even to the extent of applying entire coat if necessary, and clean deteriorated surfaces before applying touch-up coat.

- B. Shop coat exposed ferrous surfaces, not painted, with grease or other suitable protective coating. Uncoated surfaces in contact with potable water shall not be coated.

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 02667

WATER SERVICE CONNECTIONS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes

1. Requirements to furnish and install water services and fire services from the curb stop at property line to the building as indicated on the Drawings and herein specified.

B. Related Sections

1. Section 02200 - Earth Excavation, Backfill, Fill and Grading Excavation
2. Section 02215 - Aggregate Material
3. Section 02619 – Valves and Fittings
4. Section 03300 - Cast-in-Place Concrete

1.02 SUBMITTALS

A. Submit the following in accordance with Article 6.17 of the General Conditions and Section 01300 - Submittals:

1. Manufacturer's specifications, catalog data, descriptive matter, illustration, diagrams, etc.
2. Operating instructions and parts list.

1.03 REFERENCES

A. All pipe fittings and accessories shall conform to the requirements of the following standard specifications:

1. ANSI/AWWA C800, Underground Service Line, Valves and Fittings
2. ASTM B88 – Standard Specification for Seamless Copper Water Tube

PART 2 PRODUCTS

2.01 SERVICE CONNECTIONS

- A. All domestic water services shall be replaced with Type K soft copper tubing, 1-inch minimum diameter or as indicated on Contract Drawings, conforming to ASTM B-88-49, and have valve box installed and a new curb stop.
- B. All Lead services shall be removed and be disposed of legally.

2.02 CURB STOPS (NOT USED)

- A. 1-inch, lead free brass manufactured by MacDonald or approved equal.
- B. Ball valve type, ends as required to suit type of pipe or tubing to be connected, and a combined cap and tee handle and shall open **LEFT** (counter clockwise) and a drain shall not be allowed.

2.03 CORPORATION STOPS (NOT USED)

- A. Lead free brass manufactured by MacDonald, or approved equal.
- B. Corporations for 1-inch installation shall be heavy pattern, solid plug, easy turning. The inlet shall be an AWWA (CC) thread.
- C. The 1 ½-inch and 2-inch corporations shall be of a ball valve type which incorporates Teflon seats to assure self-centering of a Teflon coated bronze ball. The corporation shall be easy turning and non binding with AWWA (CC) inlet thread.
- D. Corporations subject to a sustained hydraulic pressure of 200 PSI. All saddles for 1 ½ and 2-inch corporations shall have stainless steel straps
- E. Outlet connections shall be of the type required to suit the pipe or tubing connected.

2.04 LINE FITTINGS

- A. If required, shall be standard three-part unions conforming to AWWA C800.
- B. Lead free brass manufactured by MacDonald, Mueller or Ford.

2.05 SERVICE BOXES (NOT USED)

- A. Services boxes shall be brass plug cover with inlaid covers with the word "WATER" cast into the top. Boxes shall be asphalt coated, cast iron, sliding type. Erie type or equal with a 1" diameter telescoping top pipe section.
- B. The shaft shall be 2 ½" inside diameter with extension rod.

PART 3 EXECUTION

- A. Water service and fire service connections shall be replaced from the curb stop to the building as shown on the Contract Drawings unless otherwise directed by the Engineer.
- B. Service shall be maintained as continuously as possible.
- C. Services shall be flushed before activating to avoid meter clogging.
- D. Service connections shall be free from leaks and may be pressure tested through the water main as directed by the Engineer.
- E. The Engineer must inspect all service connections under normal water main pressure prior to backfilling of the service trench to inspect for leakage.

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 02704

PIPELINE PRESSURE AND LEAKAGE TESTING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This section includes the following:

1. Perform field hydrostatic pressure and leakage testing of water main pipe.
2. Prepare and submit final test result report.

- B. Related sections include the following:

1. Section 01300 – Submittals
2. Section 02618 – Ductile Iron Pipe and Fittings for Water Main

1.3 SYSTEM DESCRIPTION

- A. Pipe installed as water main under Section 02618 shall be tested in accordance with Article 13 of the General Conditions and with the requirements of this section.
- B. Gravity sewer main or storm drains shall NOT be tested under this section.

1.4 REFERENCES

- A. ANSI/AWWA C600, Installation of Ductile-Iron Water Mains and Their Appurtenances

1.5 SUBMITTALS

- A. Shop Drawings: Submit the following in accordance with Section 01300 – Submittals

1. Name and qualifications of the third-party leakage and pressure testing subcontractor.
2. Testing schedule and test procedure.
 - a. Indicate proposed time and sequence of testing on schedule.
 - b. Indicated test procedure requirements as follows:
 - (1) Limits of each pipe to be tested.
 - (2) Position of all valves during testing.
 - (3) Location of temporary bulkheads.
 - (4) Proposed method for neutralizing chloramines in test water.
 - (5) Other applicable procedures.

1.6 SEQUENCING AND SCHEDULING

- A. Complete pressure and leakage testing of pipes prior to final cleaning; Engineer shall be present during all testing.
 - 1. Notify Engineer of time and place of testing at least five (5) days prior to commencement of work.

PART 2 PRODUCTS

2.1 EQUIPMENT

- A. Provide test equipment as follows:
 - 1. Piping connections between pipe tested and water source.
 - 2. Equipment, materials, and facilities required to perform specified tests including but not limited to the following:
 - a. Pumping equipment
 - b. Water meter
 - c. Calibrated pressure gauges
 - 3. Sectionalizing devices required including but not limited to the following:
 - a. Flanges
 - b. Valves
 - c. Bulkheads
 - d. Bracing
 - e. Blocking
 - f. Restraints

PART 3 EXECUTION

3.1 PREPARATION

- A. Provide blocks, anchors, and supports for pipe being tested and adjacent existing pipe, valves and fittings before test pressure is applied.

3.2 INSTALLATION

- A. Water:
 - 1. Schedule filling of line with Engineer at least five (5) days in advance of testing.
 - 2. Do not allow water to enter other parts of the pipeline, not subject to testing, unless approved by the Engineer.
 - 3. Neutralize chloramines prior to discharge of test water.
- B. Venting:

1. Confirm that air release valves and other venting devices are installed according to the Contract Documents and in accordance with the manufacturers' instructions and are placed in open position when filling pipe with water.
2. Do not close hand-operated vent valves until water flows in an uninterrupted stream from each valve.

3.3 APPLICATION

A. Third-Party Testing

1. Leakage and pressure testing shall be performed by the Contractor's third-party subcontractor.

B. Pressure Testing:

1. All pipe and appurtenances installed shall be hydrostatically tested in accordance with ANSI/AWWA C600, latest version, unless stated otherwise herein.
 - a. Test pressure shall be measured and applied at the elevation of horizontal center line of pipe at selected location.
 - b. Confirm pressure gauges are accurately calibrated.
 - c. Do not attempt pressure testing until all air has been vented from the mains.
2. All new water mains which shall become the property of the Owner shall be pressure tested at 200 psi for a continuous period of two hours.
3. After applying test pressure, wait until pressure stabilizes before starting test.

C. Leakage Testing:

1. Conduct leakage testing in conjunction with pressure tests.
2. Confirm that joints in piping are watertight and free from visible leaks during leakage test.
3. Leakage Test Pressure:
 - a. Maintain specified test pressure for pressure testing of reach during leakage test.
 - b. Maintain hydrostatic pressure within plus or minus 5 psi during entire time of leakage measurements.
4. Leakage Measurement:
 - a. Do not attempt measurement of leakage until pipe has been filled and allowed to sit for 24-hours, trapped air has been vented and constant test pressure has been established.
 - b. Measure leakage by means of an approved calibrated barrel on the suction side of the pump.
 - (1) Confirm that water barrel is accurately calibrated.

5. Allowable Leakage:

- a. Pump the main to specified test pressure. When pressure is reached, stop pump. If pressure drops 5 psi or more, start pump and measure the quantity of water required to maintain the specified pressure. Repeat this process as required.
- b. Ensure that pipe reach does not exceed the allowable leakage rate and does not exceed the allowable hydrostatic variation specified in Paragraph 3.3.C3b.
- c. Calculate allowable leakage with following formula:

$$Q = 0.0068 DLN \text{ where}$$

Q = allowable leakage in gallons per hour

D = nominal diameter of pipe in inches

L = length of section tested in thousand feet (1000-foot maximum). Where line valves are spaced further than 1,000- feet, the actual distance of the spacing shall be allowed.

N = square root of avg. test pressure in psi (N=12.25 for 150 psi test pressure; N=10.00 for 100 psi test pressure). The following table is derived from that calculation for specific pressures and pipe diameters.

Hydrostatic Testing Allowance per 1,000 Feet of Pipeline - gallons per hour

Average Test Pressure (psi)	Nominal Pipe Diameter in Inches												
	3	4	6	8	10	12	14	16	18	20	24	30	36
300	0.35	0.47	0.71	0.94	1.18	1.41	1.65	1.88	2.12	2.36	2.83	3.53	4.24
275	0.34	0.45	0.68	0.90	1.13	1.35	1.58	1.80	2.03	2.26	2.71	3.38	4.06
250	0.32	0.43	0.65	0.86	1.08	1.29	1.51	1.72	1.94	2.15	2.58	3.23	3.87
225	0.31	0.41	0.61	0.82	1.02	1.22	1.43	1.63	1.84	2.04	2.45	3.06	3.67
200	0.29	0.38	0.58	0.77	0.96	1.15	1.35	1.54	1.73	1.92	2.31	2.88	3.46
175	0.27	0.36	0.54	0.72	0.90	1.08	1.26	1.44	1.62	1.80	2.16	2.70	3.24
150	0.25	0.33	0.50	0.67	0.83	1.00	1.17	1.33	1.50	1.67	2.00	2.50	3.00
125	0.23	0.30	0.46	0.61	0.76	0.91	1.06	1.22	1.37	1.52	1.82	2.28	2.74
100	0.20	0.27	0.41	0.54	0.68	0.82	0.95	1.09	1.22	1.36	1.63	2.04	2.45

- d. If a length of main consists of various diameters, calculate allowable leakage (Q) separately for each diameter and its respective length. The minimum calculated allowable leakage rate obtained shall be the allowable leakage (Q) for the entire reach of main being tested.
- e. If testing of multiple valved sections is allowed, the allowable leakage for each valved segment shall be calculated and the minimum value obtained shall be the allowable leakage allowed (Q) for the entire length of main being tested.
- f. If multiple valved sections are tested, each valve in the segment shall be closed and pressure tested for a minimum of 15-minute period. This testing is in addition to the pressure and leakage testing specified herein.
- g. Measure and record volume of water pumped into main to maintain test pressure. If actual volume exceeds the allowable, Contractor shall stop test, repair leaks, and retest, all at no additional cost to the Owner.

3.4 FIELD QUALITY CONTROL

- A. Inspection:
 - 1. Locate defective joints and pipe materials during pressure testing.
 - 2. Locate and repair leaking joints, valves and other defective items of work to reduce pipe leakage to a rate less than or equal to that which is specified for the pipe or valve. Repairs shall be made at no additional cost to the Owner.
- B. Repairs
 - 1. Repairs to pipelines shall require removal of the defective section of pipe, joint, valve or fitting.
 - 2. New materials to replace those replaced as described above shall be installed with mechanical joint solid sleeves. All mechanical joints shall be installed with restraints as specified in Section 02618 – Ductile-Iron Pipe and Fittings for Buried Service.
- C. Upon completion of repairs, Contractor shall repeat the pressure-leakage test until satisfactory results are obtained, at no additional cost to the Owner.
- D. All repairs, including labor, materials, equipment, traffic details, paving and other related costs required to locate and repair defective work shall be performed at no additional cost to the Owner.
- E. Upon completion of the pressure testing, submit complete written documentation of the testing to the Engineer. Report shall be neatly prepared and bound. Copies of field notes are not acceptable for this requirement. Documentation shall consist of the following:
 - 1. Dates, time and sequence of testing.
 - 2. List and description of all equipment used in the testing.
 - 3. Names of personnel who conducted the testing.
 - 4. Test procedure requirements as follows:
 - a. Limits of each pipe tested.
 - b. Position of all valves during testing.
 - c. Leakage calculations (theoretical and actual)
 - d. Other applicable procedures.
 - 5. Test results by segment listing test pressure and amount of makeup water.
 - 6. Description of leaks repaired and method used to make repairs.
- F. Release of final retainage will be withheld until receipt of satisfactory test result data by the Engineer.

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 02763

PIPELINE CLEANING

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes

1. Requirements for cleaning and TV inspection of sewer pipes.

B. Related Sections

1. Section 01570 - Traffic Regulation
2. Section 02149 - Maintaining Existing Flow
3. Section 02764 - Television Inspection
4. Section 02767 – Disposal of Materials

1.02 REFERENCES

A. National Association of Sewer Service Companies

1. NASSCO Recommended Specifications for Sewer Collection System Rehabilitation.

1.03 CLEANING AND DISPOSAL REQUIREMENTS

- A. The Contractor's attention is directed to the requirements set forth by the Commonwealth of Massachusetts, Department of Environmental Protection (MADEP) regarding "Special Wastes" and the proper disposal thereof. All waste materials and debris, as designated by the Owner and/or Engineer including but not limited to any pump station, sewers and associated structures, or any portions thereof, including but not limited to sludge, grit sediment, dirt, sand, rock, grease, roots and other liquid, solid or slime-solid material contained therein, shall be considered, "Special Wastes".
- B. Remove dirt, grease, rocks, sand, iron tuberculation and other materials and obstructions from the pipeline.
- C. Pipeline Cleaning shall be performed by hydraulically propelled or high velocity jet cleaning equipment. Selection of equipment shall be based on such field conditions as access availability and type of debris to be removed.
- D. Clean pipeline to restore a minimum of 95 percent of the original carrying capacity of the pipe, and suitably to permit lining of the pipeline.

- E. The Contractor is required to test and dispose of any waste material removed from the pipeline in accordance with State and Federal requirements. Testing of waste material will be at the Contractor's expense.
- F. The Contractor shall notify the Engineer of the proposed disposal location and requirements of that disposal facility to allow disposal of waste material.
- G. The Contractor is required to store any waste material until all testing requirements of the proposed facility have been met and shall submit copies of all test results to the Engineer.

1.04 SUBMITTALS

- A. Submit in accordance with Article 6.17 of the General Conditions and Section 01300 - Submittals.
 - 1. Provide detailed plans and descriptions outlining cleaning and television inspection procedures and all provisions and precautions regarding the handling of existing sewage flows.

1.05 QUALITY ASSURANCE

- A. Perform general work in accordance with NASSCO recommended specifications for sewer collection system rehabilitation.

1.06 QUALIFICATIONS

- A. Company specializing in performing the work of this section with minimum of three (3) years experience.

1.07 TRAFFIC CONTROL

- A. In accordance with Specification Section 01570 – Traffic Regulations.

PART 2 PRODUCTS NOT USED

PART 3 EXECUTION

3.01 CLEANING PROCEDURES

- A. Sewer Cleaning
 - 1. The designated pipelines shall be cleaned using hydraulically propelled or high velocity jet cleaning equipment.

2. Selection of the equipment used shall be based on the conditions of the lines at the time the work commences.
3. Equipment and methods selected shall be satisfactory to the Engineer.
4. Equipment selected for cleaning shall be capable of removing dirt, grease, rocks, sand, iron tuberculation and other deleterious materials and obstruction from the pipelines.

B. Material Removal

1. Sludge, dirt, sand rocks, grease and other solid or semi-solid material resulting from the cleaning operation shall be removed at the downstream manhole of the section which could cause line stoppages.

C. Disposal of Materials

1. Solids or semi-solids resulting from the cleaning operations shall be removed from the site and disposed in accordance with Specification Section 02767 – Disposal of Materials.

D. Cleaning Precautions

1. During all pipeline cleaning operations, satisfactory precautions shall be taken to protect the pipelines from damage that might be inflicted by the improper use of cleaning equipment.
2. Whenever hydraulically propelled cleaning tools, which depend upon water pressure to provide their cleaning force or any tools which retard the flow of water in the pipeline are used, precautions shall be taken to ensure that the water pressure created does not cause any damage or flooding to public or private property.
3. The flow of sewage in the sewer lines shall be utilized to provide necessary pressures by hydraulic cleaning devices whenever possible.
4. When additional quantities of water from fire hydrants are necessary to avoid delay in normal working procedures, the water shall be conserved and not used unnecessarily.
5. No fire hydrant shall be obstructed in case of a fire in the area served by the hydrant nor shall a hydrant be used for the purpose described unless a vacuum break is provided.

E. Pumping and flow bypassing

1. The Contractor shall complete the cleaning during periods of low flow between the hours of 10:00 pm and 5:00 am.

F. Flow Control Precautions

1. Whenever flows in a sewer line are blocked, plugged or bypassed, sufficient precautions must be taken to protect the sewer lines from damage that might be inflicted by excessive sewer surcharging.
2. Further, precautions must be taken to ensure that sewer flow control operations do not cause flooding or damage to public or private property being served by the sewers involved.
3. Coordination with private property owners is required.

END OF SECTION

SECTION 02769

DISPOSAL OF MATERIALS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes

1. Requirements for disposal of materials resulting from the cleaning of sewer pipes, parshall flume chamber, and wet well.

B. Related Sections

1. Section 02080 – Soil and Waste Management.

1.02 SUBMITTALS

A. In accordance with Specification Section 01300, submit the following

1. Outline of the procedures proposed to accomplish the work.
2. Include a detailed description of disposal methods and locations of disposal.

PART 2 PRODUCTS NOT USED

PART 3 EXECUTION

3.01 DISPOSAL PROCEDURES

- A. Material encountered in the cleaning of sewer pipes, parshall flume chamber, and wet well are considered “Special Waste” by the Commonwealth of Massachusetts, Department of Environmental Protection (MADEP). The materials include sludge, sand, grit, debris, etc.
- B. The Contractor is required to test and dispose of any waste material removed from pipeline, manholes, etc. within the project area in accordance with State and Federal requirements. Testing of waste material will be at the Contractor’s expense.
- C. The materials being removed from the pipelines, parshall flume, wet well, and manholes during the cleaning process shall be deposited in such a manner as to not endanger the public, plant personnel or persons performing the work. Such debris deposits may be of such nature, high in biological organic contents, or chemically aggressive that they will require proper disposal in a safe, health risk free, environment. The Contractor shall contact the Owner and Engineer and all agencies having jurisdiction thereof, for approval of debris disposal methods and locations of disposal, prior to disposing of any or all debris removed from cleaning methods. All solids or semi-solids resulting from the cleaning operations shall be removed and satisfactorily disposed of off-site at the Contractor’s expense.

- D. Debris must be transported in a watertight vehicle. The Contractor must ensure that no water leaks from the vehicle in any manner during the transportation. The Contractor is solely responsible for any cleanup of debris on route to disposal at a licensed disposal facility. The Contractor is also responsible for the payment of any fines that are incurred as a result of any incident which occurs during the transportation and/or disposal of the contents of the vehicle.
- E. Disposal must be at a licensed facility that is regulated to accept and properly dispose of the debris that is normally expected to be in a wastewater collection system.

END OF SECTION

SECTION 02831

CHAIN LINK FENCING

PART 1 – GENERAL.

1.01 SUMMARY

A. Section Includes

1. Requirements for chain link fences, including gates, posts and post foundations, hardware and appurtenances, of various types and configurations at the locations indicated on the Drawings or as directed by the Engineer, all in accordance with this Specifications.

B. General Requirements

1. The Contractor shall provide all labor, equipment, materials and accessories necessary to install all chain link fence and gate.

C. Related Sections

1. The Contractor shall provide all labor, equipment, materials and accessories necessary to install all chain link fence and gate.
2. 01300 – Submittals
3. 03300 – Cast-in-Place Concrete

1.02 REFERENCES

A. AASHTO M181 – Chain-Link Fence

- ###### B. "Standard Specifications for Road and Bridge Construction" of the Rhode Island Department of Transportation, latest revision, herein referred to as "State Standards".

1.03 SUBMITTALS

- ###### A. Submittals for all products incorporated into this work shall be made in accordance with the requirements as specified in Section 01300, SUBMITTALS.

B. The Contractor shall submit the following to the Engineer for approval:

1. Three samples, approximately 6 inches long or 6 inches square, of fabric material, post section, and typical accessories.
2. Shop drawings showing fence height, sizes of posts, rails, braces, gates, footings, accessories, bending strengths, and assembly.
3. Manufacturer's certified test data demonstrating compliance with all performance specifications for color coating of framework and fabric.

1.04 QUALITY CONTROL

- A. Shop welding shall be in conformance with the latest AWS standards, and no field welding shall be required.
- B. Wire gauges shall conform to American Steel and Wire Co. gauges.
- C. Bolts, washers, and nuts shall be galvanized steel in conformance with the requirements as specified in Section 05500, Miscellaneous Metals.
- D. Mild steel bars and shapes shall conform to ASTM A36.
- E. Unless noted otherwise, fencing and all components are to be color-coated BLACK. Manufacturer shall have a minimum 5 years experience manufacturing thermally-fused chain link fencing and all appurtenances.

PART 2 – PRODUCTS

2.01 GENERAL

- A. All fencing and appurtenances shall be provided by a single manufacturer and all components shall match in color as specified.
- B. The overall height of ground-mounted fence shall be 8 feet.
- C. All fence components including, but not necessarily limited to, framework, hardware, fabric, gates and accessories shall be vinyl-coated as specified. The Contractor shall submit color patterns that will be selected; and the Engineer will select the color. Consistency of color shall be controlled by establishing Munsell color specifications in accordance with ASTM D-1535, and holding colors within tolerances approved by the Engineer.
- D. Members having structural sections other than those specified herein may be submitted for the Engineer's consideration of architectural appearance provided that such members have minimum bending strengths equal to those of pipe posts specified herein. Bending strength as used herein is defined as the concentrated force applied eight feet from a cantilever support in which the member is embedded (such as the ground) at which incipient permanent bending deformation results. Where square or roll-formed sections are used, the Contractor shall submit data demonstrating that the sections have minimum bending strengths in all directions equal to those of pipe sections specified herein or are otherwise of adequate bending strength. Manufacturer shall submit test data and/or computations to verify bending strength as part of his shop drawing submittal.

2.02 VINYL-COATED CHAIN LINK FABRIC

- A. Vinyl-coated steel chain link fabric shall be No. 9 finished gauge, woven wire, to a uniform square mesh measuring $2\pm 1/8$ -inches between its parallel sides. Galvanized core wire shall be No. 10-1/2 gauge, of good commercial quality steel and shall be uniformly galvanized with a zinc-coat-weight of at least 0.30 oz per sq. ft. The galvanized wire shall then be coated with a molecular bonding layer and a minimum 20 mil vinyl coating, continuously extrusion-bonded (not sprayed or dipped) by a thermal extrusion-bonding process to insure a dense and impervious covering, free of voids and having a smooth and lustrous appearance. Unbonded coatings are not acceptable. The vinyl coating shall not be capable of being stripped from the wire with wire strippers. The wire shall be vinyl-clad before weaving and shall be free and flexible at all joints. The bond shall exhibit equal or greater strength than the cohesive strength of the vinyl. All cut ends shall be coated with vinyl at the factory during the weaving process.
- B. The fabric wire shall have a minimum breaking strength of 850 lbs. when tested per U.S. Government Spec. RR-F—191/1A.
- C. The vinyl in the color coating shall be a plasticized polyvinyl chloride (PVC) with low temperature (-20 deg F) plasticizer and no fillers, extenders, or extraneous matter other than the necessary stabilizers and pigments. The PVC shall have a specific gravity of 1.3 (ASTM D792), tensile strength of 2,600 psi minimum (ASTM D412), ultimate elongation of 275 percent (ASTM D412), hardness of 85 minimum Type A durometer (ASTM 2240), and minimum 750 volt dielectric strength per mill (ASTMD149). The color coating shall be stabilized and shall withstand a minimum weatherometer exposure of 1,500 hours without any discolorization or other deterioration (Test Equipment Operating Light and Water Exposure Apparatus Carbon-Arc Type, ASTM D-1499, G23, Type E). The coating shall also withstand an accelerated weatherometer aging test of a minimum of 1,500 hours at 145 deg F (ASTM D1499) without showing signs of fading, cracking, blistering, or splitting. When tested, both before and after the weatherometer tests at temperatures down to -20 deg F, the coating shall remain flexible and shall not rupture, split, or separate from the core wire when bent around a mandrel with a diameter 10 times that of the wire. The vinyl covering shall, in addition, resist attack from prolonged exposure to dilute solutions of most common mineral acids, seawater, and dilute solutions of most salts and alkalis.
- D. Fabric shall measure 8 feet in height and be knuckled at top selvage and twisted and barbed at bottom selvage.
- E. Fabric shall be fastened to all rails and line posts by means of No. 6 gauge zinc-coated and color-coated wire ties spaced approximately 12 inches O.C. Fabric shall be fastened to end, corner, pull and gate posts by means of zinc and vinyl-coated tension bars, held in place at 12-inch intervals by zinc and vinyl-coated tension bar

bands, nuts, and bolts. Tension bars shall be ¼ inch by ¾ inch and full height of fabric.

2.03 FRAMEWORK AND HARDWARE

- A. All framing and accessories shall be provided as required to complete the fence system.
- B. All posts, rails, braces, and accessories shall be color-coated. Before color is applied, all materials shall be thoroughly cleaned by effective means to remove all loose mill scale, rust, and foreign matter, and given a protective hot dip galvanized coating inside (where applicable) and outside of not less than 1.8 oz per sq. ft. A chemical cleaning and phosphate conversion treatment shall be used to prepare zinc substrate to receive primer and vinyl coating. A minimum of 10 mils of vinyl coating shall be bonded to the to a special cross-linked epoxy phenolic primer by a thermal fusion process. Unbonded coatings are not acceptable. The resin shall have a specific gravity of 1.3 (ASTM D792), tensile strength of 2,600 psi (ASTM D412), minimum elongation of 200 percent, tear strength of 0.36 lb per mil, hardness of 85 minimum Type A durometer (ASTM D2240), minimum 750 volt dielectric strength per mill (ASTM D149), minimum 160 inch-pound impact under gardner test, volume resistivity of 2.0×10^{12} ohm/cm, and brittle temperature of minus 20 deg. F. The color coating shall be stabilized and shall withstand weatherometer exposure tests (standard ASTM Designation D1499, G23, Type D) as follows: minimum 1,000 hours without discoloration; minimum 5,000 hours without cracking, blistering, or loss of adhesion. The coating shall withstand an accelerated aging test (ASTM D1499) of a minimum of 1,500 hours at 145 deg F without any cracking or peeling, and shall exhibit a maximum shrinkage of 1/16-in. per ft. The color coating shall also withstand a salt spray test (Federal Test Standard 141 – Method 6061) of greater than 10,000 hours, with no perceptible deterioration to coating or evidence of metal corrosion for unscored samples; for scored samples after exposure of 1,000 hours, undercutting shall not exceed 1/8 inch. The protective resin coating shall not exceed 1/8 inch. The protective resin coating shall exhibit a chemical resistance after prolonged exposure at 75 deg. F to fumes and shall, in addition, resist attach from prolonged exposure to dilute solutions of most common mineral acids, sea water, and dilute solutions of most salts and alkalis.
- C. Posts and rails shall be Schedule 40 steel pipe, ASTM Designation A-120, having the following approximate outside diameters, and minimum weights per linear foot:
- | | |
|--------------------------------|-------------------------|
| 1. Line Posts | 2-1/2 inches @ 3.7 lbs. |
| 2. End, Corner, and Pull Posts | 3 inches @ 5.8 lbs. |
| 3. Rails | 1-5/8 inches @ 2.3 lbs. |
| 4. Gate Posts | 4 inches @ 9.1 lbs. |

- D. Spacing between end, corner, pull, or line posts shall not exceed 10 ft 0-in. Posts of all types shall be of sufficient length to fully support fence fabric height and allow for installation to the depth of footing specified below ground level.
- E. Post tops shall be pressed steel or malleable iron, designed to exclude moisture from the posts and receive the top rail.
- F. The fence shall have a continuous top rail for its full length. The top rail shall pass through openings provided in the line post tops, and each length shall be coupled with an internal self-centering, swaged sleeve for a distance of 6 inches.
- G. Horizontal braces (brace rail) shall be provided where required at all pull, corner, and terminal posts midway between the top rail and ground, and shall extend from pull, corner, and terminal posts to the first adjacent line posts. Braces shall be securely fastened to the line posts, pull, corner, and terminal posts by rail ends and brace bands. Brace rails shall be vinyl-bonded, galvanized steel, 1-5/8 inches outside diameter pipe, weighing not less than 2.3 pounds per linear foot with plain ends. Each corner and pull post shall be braced and trussed on two sides; each terminal post shall be braced and trussed on one side.
- H. Diagonal braces (truss rods) shall be provided with all horizontal braces and shall be trussed from the brace ends on the line post back to the bottom of pull, corner or terminal post. The diagonal brace rods shall be galvanized steel, 3/8-inch diameter. Each brace rod shall be provided with a heavy malleable iron hot-dip zinc-coated turnbuckle to provide means for adjusting the tension in the diagonal brace.

2.04 GATES

A. General

1. Steel gate frames and other steel components shall be color-coated as specified for framework and hardware above. Aluminum gate frames shall be color-coated per manufacturer's recommendations. Painting of hardware and accessories is unacceptable.
2. The fabric shall be of the same material as for fence, and shall be attached to the gate frame on all four sides by means of vinyl-coated fasteners and tension bars.
3. For each gate, heavy galvanized hardware and accessories shall be provided and shall include hinges, latches, keepers, and gate stops as appropriate.
4. Latch shall be forked type or plunger-bar type to permit operation from either side of gate. Provide padlock eyes as integral part of latch.
5. A bronze padlock, Yale and Towne No. 39-1/2 or equal, shall be furnished for each gate. The padlocks shall all be keyed alike to match the Owner's standard and be approved by the Engineer.

B. Cantilever Sliding Gate

1. The cantilever sling gate shall be "freehanging" type, single leaf, and sized as shown on the Drawings. The gate manufacturer shall supply sliding gates of

appropriate construction, which will be structurally stable and meeting the intended dimensions. The gate shall be manufactured by Anchor Fence/Master Halco Inc., Cyclone Fence, Page Fence, or approved equal.

2. The gate shall be provided with two roller truck assemblies, which operate within a combined track and top gate frame member. The roller truck assemblies shall provide vertical support and lateral movement control to insure alignment of the truck in the track. The roller truck assemblies shall be fastened to gate posts with 7/8-inch diameter ball bolts with ½-inch shank.
3. The gate frame shall be constructed of 2-inch square aluminum tubing alloy 6063-T6, weighing 0.94 lbs per linear foot, welded at the joints. The combined track and top frame member shall be extruded aluminum-sized per manufacturer's recommendations. The bottom frame member shall be 2-inch by 4-inch aluminum tubing weighting 1.71 pounds per linear foot.
4. Support posts for the cantilever slide gate shall be of 4-inch outside diameter, Schedule 40 steel pipe, ASTM A-120, as specified above.
5. Vertical uprights and diagonal truss rods shall be provided as necessary to insure rigidity of the gate frame and prevent sagging.
6. Appurtenant hardware including roller guide assemblies for each support post, latch assembly with provisions for padlocking, and gate stop assembly shall be provided.

PART 3 - EXECUTION

3.01 GENERAL

- A. The Contractor shall perform such clearing as may be necessary to construct the fence to the required grade and alignment shown on the Drawings. Installation of permanent fencing shall not begin until completion of final grading.
- B. The new fence shall be permanently tied to the terminals of existing fences where required.
- C. Top rails and fabric bottom shall be approximately parallel to final surface grade, allowing no more than 6 inches clear distance between the fabric bottom and grade.
- D. At locations of small streams or drainage ditches where it is not practical to conform the fence to the general contour of the ground surface, the Contractor, when directed, shall span the opening below the fence with wire fastened to stakes of such length as required.
- E. When directed, the Contractor will be required to stake down the chain link fence at several points between posts.
- F. At each location where electric transmission or distribution lines cross any of the types of fences covered by this Specification, the Contractor shall furnish and install a

ground conforming to the requirement of Section 9 of the National Electric Safety Code.

- G. Abrasions of color-coating shall be touched up to the Engineer's satisfaction by methods approved in writing to the Engineer. The Engineer reserves the right to require replacement of scratched or otherwise damaged fence components.

3.02 INSTALLATION OF POSTS

- A. Posts shall be set plumb, in proper alignment, and embedded in 3,000 psi concrete (State Standard Class A (AE)) unless otherwise specified on the plans or for temporary fencing. Holes for post footings shall be drilled in firm, undisturbed, or compacted soil. Concrete shall be placed in a continuous pour and crowned at top to shed water. Contractor shall install temporary guys, or braces, as may be required to support the posts in proper position until such time as the concrete has set sufficiently to anchor said posts. Concrete footings shall be carried to the depth and dimensions shown on the Drawings.
- B. Where rock is encountered within the required depth to which the post is to be erected, a hole of a diameter slightly larger than the largest dimension of the post shall be drilled into the rock and the post grouted in. The regular dimensioned concrete footing as shown on the plans shall then be placed between the top of the rock and required grade shown on the plans.
- C. All hollow pipe and tube type post shall be fitted with post tops. The bases of the post tops shall have flanges that fit around the outside of the posts and shall be secured.
- D. Pull posts shall be installed at all points of inflection greater than 30 degrees in the line of the fence and at all points of abrupt changes in grade.

3.03 INSTALLATION OF FABRIC

- A. The fabric shall be unrolled on the outside of the fence line with the bottom edge of the fabric against the posts. The various rolls shall be spliced to form a continuous mesh pattern by bringing the ends close together and weaving in a picket in such a way that will engage both ends of the rolls and catch, with each twist, each separate mesh of the picket of both rolls of fabric.
- B. At end, corner or gateposts, the stretcher bar shall be slipped through the end picket of the fabric and the stretcher bar bands at the same time. The bolts in the stretcher bar bands shall then be tightened. Additional rolls of fabric shall be spliced and placed as the erection progresses along the fence. In long sections, an intermediate pull post with horizontal braces and diagonal braces shall be provided every 500 feet.

- C. The fabric shall be placed by securing one end and applying sufficient tension to remove all slack before making attachments elsewhere. After the fabric has been stretched, it shall be attached to the line posts and rails with fabric ties spaced at 12 inches apart. The topmost clip shall be placed on the line post as near the top of the fabric as possible and lowest clip as near the bottom of the fabric as possible. At terminal sections (end, corner and pull) and gateposts, the fabric shall be fastened with stretcher bars and bands. The fastenings shall be spaced at 12 inches on centers for terminal sections (end, corner and pull) and gateposts. The topmost band shall be placed on these posts as near the top of the fabric as possible and the lowest band as near the bottom as possible.
- D. Before making a closure, the other end of the run shall be fastened to the end, corner, or gatepost as described previously. The operation of making a closure of a run shall be as follows. The stretching equipment shall be clamped on the ends of the fabric parallel to each other and about 5-feet apart when the tension is first applied. The stretching shall continue until the slack has been removed from both sections of the fabric. If the ends overlap, the fabric shall be cut to match. The ends shall be joined by the insertion of a picket similar to the methods of connecting two rolls of fabric.

3.04 INSTALLATION OF GATES

- A. Gates shall be installed plumb, level, and secure for full opening without interference. The gates shall be hung on gate fittings as shown on the plans. Gates shall be erected to slide in the direction indicated and shall be provided with gate stops as shown on the drawings.

3.05 ADDITIONAL INSTALLATION

A. Braces

- 1. When top rail is not used, braces shall be placed 12 inches down from the top of the terminal posts and shall extend from the terminal (end, corner, and pull) post and gate posts to the brace post. The braces shall be securely fastened to the post and trussed from brace post back to terminal post with round rod and turnbuckle, all as shown on the drawings.

B. Existing Fence Connections:

- 1. Whenever a new fence joins an existing fence, either at a corner or at the intersection of straight line fences, the corner post with brace post shall be set at said junction and braced the same as herein described for corner posts or as shown on the plans. If the connection is made at other than the corner of the new fence, the last span of the old fence shall contain a brace span.

3.06 INSPECTION, TESTS AND GUARANTEES

- A. The Engineer shall have the right to inspect and test any materials or their fabrication at any time during construction at the mill, shop or field. At the option of the Engineer, certified mill tests of materials may be accepted in lieu of tests.
- B. The Contractor shall furnish to the Engineer, prior to installation, notarized certification and satisfactory guarantees by the fence manufacturer covering any faults and/or defects in any part of the fence arising from defective workmanship or materials for a period of one (1) year, and any rust and corrosion for fifteen (15) years, from the date of final acceptance of the project.

END OF SECTION

SECTION 02930

LOAMING AND SEEDING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Requirements for loaming, fertilizing, seeding, and related work in areas disturbed in the process of performing the Work under this contract.

1.02 RELATED SECTIONS

- A. See Framingham Conservation Commission's Order of Conditions provided in Appendix C. The requirements set forth in Appendix C supersede requirements of this section.

1.03 SUBMITTALS

- A. In accordance with SECTION 01300 submit the following:
 - 1. Submit with seed, certificates confirming seed mixture, purity, germinating value, and crop year identification.
 - 2. Submit test samples of loam.

1.04 DELIVERY, STORAGE AND HANDLING

- A. Fertilizer:
 - 1. Delivered mixed as specified in standard size, unopened containers showing weight, analysis, and name of manufacturer.
 - 2. Store in weather proof place.
- B. Seed:
 - 1. Delivered in original unopened containers with mixture listed.

PART 2 PRODUCTS

2.01 LOAM

- A. Fertile, natural topsoil, typical of locality, without admixture of subsoil, refuse or other foreign materials, and obtained from well-drained arable site. Mixture of sand, silt and clay particles in approximately equal proportions. Free of stumps, roots, heavy or stiff clay, stones large than 1 inch in diameter, lumps, coarse sand, noxious weeds, sticks, brush or other deleterious matter.

- B. Not less than 4 percent nor more than 20 percent organic matter as determined by loss on ignition of oven-dried samples.
- C. Loam test samples dried to constant weight at temperature of 230 degrees F., plus or minus nine degrees.
- D. Use loam, having prior vegetative growth that did not contain toxic amounts of either acid or alkaline elements.

2.02 LIME, FERTILIZER AND SEED

- A. Ground agricultural limestone containing not less than 85 percent of total carbonates.
- B. Complete fertilizer, at least 50 percent of nitrogen derived from natural organic sources of ureaform and containing following percentages by weight:

Nitrogen 10% Phosphorus 10% Potash 10%

- C. Turf grass seed, clean, high in germinating value and latest year's crop mixture as follows:

Name	Minimum Proportion by Weight	Percent Purity	Percent Germination
Kentucky bluegrass	20%	87%	85%
Merion Kentucky bluegrass	20%	87%	85%
Red Chewings fescue	45%	98%	85%
Italian rye	15%	98%	90%

PART 3 EXECUTION

3.01 GENERAL

- A. Supply suitable quantities of water, hose and appurtenances.

3.02 LOAM

- A. Spread loam on areas to 6-inch depth after compaction, fine grade and compact.

3.03 LIME, FERTILIZER AND SEEDING

- A. Apply lime by mechanical means at rate of 3000 pounds per acre.
- B. Apply fertilizer at rate of 1200 pounds per acre.
- C. Remove weeds or replace loam and reestablish finish grades, if any delays in seeding lawn areas and weeds grow on surface or loam is washed out prior to sowing seed and without additional compensation. Sow seed at rate of 175 pounds per acre on calm day, by mechanical means. "Hydro-Seeding" not permitted unless otherwise permitted or required by Engineer. Sow one-half of seed in one direction, and other half at right angles to original direction. Rake seed lightly into loam, to depth of not more than 1/4 inch and compact by means of an acceptable lawn roller weighing 100 to 150 pounds per linear foot of width.
- D. Water lawn areas adequately at time of sowing and daily thereafter with fine spray, and continue throughout maintenance and protection period.
- E. Seed during approximate time periods of April 1 to May 15 and August 15 to October 1, and only when weather and soil conditions are suitable for such work, unless otherwise permitted.

3.04 MAINTENANCE OF SEEDED AREAS

- A. Maintain lawn areas and other seed areas at maximum height of 2-1/2 inches by mowing at least three times. Weed thoroughly once and maintained until time of final acceptance. Reseed and refertilize with original mixtures, watering or whatever is necessary to establish over entire area of lawn and other seeded areas a close stand of grasses specified and reasonably free of weeds and undesirable coarse native grasses.
- B. Begin maintenance immediately after each portion of lawn is seeded and continue for minimum of 45 days.
- C. Repair or replace all seeded areas which, in judgment of Engineer, have not survived and grown in satisfactory manner, for a period of one year after acceptance.
- D. Seeding replacement, same seed mixture as specified and furnished and installed as specified.

3.05 TEMPORARY COVER CROP

- A. Sow a temporary cover crop of buckwheat, domestic rye grass or other acceptable seed if there is insufficient time in the planting season to complete seeding, fertilizing, and permanent seeding at the option of Contractor or order of Engineer. Cut and water cover crop as necessary until the beginning of the following planting

season, at which time it shall be plowed or harrowed into soil, the areas shall be fertilized and permanent seed crop sown as specified.

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

DIVISION 03

THIS PAGE INTENTIONALLY LEFT BLANK

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

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.
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. In accordance with ASTM C150, Type II of U.S. manufacture.
2. Only one brand of cement shall be used on the project.

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. New, deformed billet steel bars, in accordance with ASTM A615, Grade 60.

H. Welded Wire Fabric

1. In accordance with ASTM A185.

I. Accessories.

1. Reinforcement accessories, consisting of spacers, chairs, ties, and similar items shall be provided as required for spacing, assembling, and supporting reinforcement in place.
2. All accessories shall be dielectric coated steel or approved plastic accessories, conforming to the applicable requirements of the CRSI Standards.

J. Tie wire.

1. 16 gauge or heavier black annealed wire.

K. Form Ties and Spreaders.

1. Standard metal form clamp assemble and plastic cone, of type acting as spreaders and leaving no metal within 1 inch of concrete face.

2. Provide form tie with water stop for all walls to be in contact with earth or liquid.
 3. Inner tie rod shall be left in concrete when forms are removed.
 4. No wire ties or wood spreaders will be permitted. Use ½" x 1" C.T. plastic cones for sinkages.
- 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. High-strength, non-shrink grout with saltwater resistance.
 2. Five Star Special Grout 120 or equivalent.

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 with the method of placing employed not he work, 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

A. Falsework for Forms

1. Build and maintain necessary false work for the forms.

B. Construction of Forms

1. General

- a. Construct in accordance with ACI 347.
- b. Construct of sound material, to the correct shape and dimensions, mortar tight, of sufficient strength, and so braced and tied together that the movement of men, equipment, materials, or placing and vibrating the concrete will not throw them out of line or position.

2. Embedded Items

- a. Make provisions for pipes, sleeves, anchors, inserts, reglets, anchor slots, nailers, water stops, and other features.
- b. Do not embed wood, other than necessary nailing blocks, in concrete.
- c. Extended complete cooperation to suppliers of embedded items in their installation.
- d. Secure information for embedded items from other trades as required.
- e. Securely anchored embedded items in correct location and alignment prior to placing concrete.

3. Openings for Items Passing Through Concrete

- a. Establish exact locations, sizes, and other conditions required for openings and attachment of work specified under other sections.
- b. Coordination work of this nature in order that there will be no unnecessary cutting and patching of concrete.
- c. Cutting and repairing of concrete as a result of failure to provide for such openings shall be paid for by the Contractor at no additional expense to the Owner.

C. Removing Forms and False work

1. Forms shall not be removed for at least 72 hours after concrete has been placed.
2. Forms shall not be removed until the concrete has attained sufficient strength to insure stability.

3.02 REINFORCING STEEL

A. General

1. Place reinforcing steel in accordance with the drawings and approved shop drawings and the applicable requirements of the CRSI, Manual of Practice.
2. Install reinforcement accurately and secure against movement, particularly under the weight of workmen and the placement of concrete.

B. Reinforcing Steel Supports

1. Support bars on approved plastic or dielectric-coated metal chairs or spacers, accurately placed and securely fastened to forms or steel reinforcement in place.
2. Supply additional bars, whether specifically shown on the drawings or not, where necessary to securely fasten reinforcement in place.
3. Support legs of accessories in forms without embedding in form surface.
4. Spacing of chairs and accessories shall conform to CRSI, Manual of Standard Practice. Accurately space hoops and stirrups and wire to the reinforcement.
5. Permit no loose wood inside forms.
6. Lifting of welded wire fabric into proper position while concrete is being poured rather than supporting fabric on chairs will not be permitted.

C. Placing and Tying

1. Set in place, space, and rigidly and securely tie or wire with tie wire at all splices and at all crossing points and intersections in the positions shown, or as directed.
2. Rebending of bars on the job to accommodate the job to accommodate existing conditions will not be permitted without the written approval of the Engineer
3. Points ends of wire ties away from forms.

D. Spacing

1. Minimum center to center distance between parallel bars shall be in accordance with the details on the drawings, or, where not shown, the clear spacing shall be 2 times the bar diameter but in no case less than 1½ inches or less than 1½ times the maximum size aggregate.

E. Splices

1. Maximum 50% of steel spliced occurring within lap length.
2. Top bars shall be 1.3 times values given in 3.01.D.5.c.
3. Splice lengths.
 - a. #6 bars and smaller: 50-bar diameter
 - b. #7 bars and larger: 60-bar diameter

F. Concrete Covering

1. In accordance with ACI 315, except where shown otherwise on drawings.

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

- a. 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.
- b. Immediately before concrete is placed, inspect all forms to ensure 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.
- c. Concreting, once started, shall be carried on as a continuous operation until the section of approved size and shape is completed.
- d. 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.
- e. 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.
- f. Concrete that has partially hardened shall not be deposited in the work.

F. Pumping

- a. Concrete may be placed by pumping if first approved in writing by the Engineer for the location proposed.
- b. 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.
- c. 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.
- d. Concrete shall not be pumped through aluminum pipes.

G. Vibrating and Compacting

- a. 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.
- b. 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.
- c. 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.

- d. 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 on inch.
- e. The responsibility for providing fully filled out, smooth, clean, and properly aligned surfaces free from objectionable pockets shall rest entirely with the Contractor.

3.04 CONSTRUCTION JOINTS

- A. 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.
- B. 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.
- C. Approved keys shall be used at all joints, unless detailed otherwise.
- D. Forms shall be retightened before placing of concrete is continued. There shall be an interval of at least 48 hours between adjacent pours.
- E. 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.

3.05 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 1/4-inch.
2. Saturate surface with water for 24 hours, cover with epoxy bonding compound and place concrete as specified for new concrete.

3.06 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.

3.07 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.

3.08 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.

3.09 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.

3.10 CONCRETE FINISHES

1. Unexposed Surfaces: All unexposed surfaces shall have any form finish, at the Contractor's option.
2. Wearing Surface Finish: Float the surface by hand using a wooden or magnesium float. Finish with a flexible bristle broom. Permit surface to harden sufficiently to retain the scoring or ridges. Broom transverse to traffic or at right angles to the slope of the slab.
3. Addition of Material: The addition of cement, sand, water, or mortar to slab surfaces while finishing concrete is strictly prohibited.

3.11 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 03930

CONCRETE REHABILITATION

PART 1 GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. Crack Repairs by Epoxy Injection: Section 03940.

1.02 REFERENCES

- A. Except as shown or specified, the Work of this Section shall conform to the requirements of International Concrete Repair Institute (ICRI), 3166 S. River Rd., Suite 132, Des Plaines, IL 60018, (847) 827-0830, www.icri.org.
 - 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).

1.03 SUBMITTALS

- A. Product Data: Manufacturer's specifications and installation instructions for factory packaged products.

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. 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. Deliver materials to the site in original, sealed containers. Do not deliver materials that have exceeded shelf life limitation set forth by the manufacturer.
- B. Comply with manufacturer's printed instructions for storing and handling materials.

1.06 PROJECT CONDITIONS

- A. Environmental Requirements: Comply with the product manufacturer's printed limitations and instructions.

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:
 - 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. 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.
- D. 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.

- E. 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 PREPARATION

- A. Protection: Cover or otherwise protect adjacent surfaces not being repaired.
- B. Surface Preparation:
 - 1. Prepare surfaces to be repaired in accordance with the product manufacturer's printed instructions and as specified.
 - 2. Cut out and remove cracked, spalled, and disintegrated concrete. Cut back to sound concrete. Cut edges of patch perpendicular to surface of patch, unless otherwise recommended by mortar manufacturer. If steel reinforcing bars are exposed, chip concrete out from behind exposed length of bars as required for a minimum clearance around circumference of bar of 3/4 inch. In addition, cut a minimum one inch length of sound concrete away from each end of exposed length of reinforcing bars.
 - 3. Clean exposed steel reinforcement by oil-free abrasive blasting or high-pressure water blasting; remove bits of concrete and loose rust. If reinforcement is bowed out toward surface of the concrete, bend reinforcement back from surface.
 - 4. Remove paint, oils, grease, dirt, salt deposits, laitance and other contaminants from surfaces to be patched. Use cleaning agent where required.
 - 5. Clean areas to be patched with oil-free air or water under pressure, except as otherwise recommended by the mortar manufacturer.

3.02 COATING REBAR

- A. Coat reinforcing as soon as possible after completion of surface preparation.
- B. Place reinforcement coating complying with manufacturers printed instructions.

3.03 PATCHING CONCRETE

- A. Patch concrete as soon as possible after completion of surface preparation.
- B. Mixing Patching Mortar: Comply with mortar manufacturer's printed instructions. Proportion components and sizes of aggregate as recommended by mortar manufacturer for the particular job conditions.
- C. Patch concrete in accordance with the product manufacturer's printed instructions.
 - 1. Coat contact surfaces of existing concrete and steel reinforcing with a bonding agent/primer as recommended in the product manufacturer's instructions.
- D. Bring patches out to the original surfaces in true planes. Finish patches to match texture of adjoining concrete as close as possible.
- E. Cure patches in accordance with the product manufacturer's printed instructions.

3.04 CLEANING

A. Clean up spatters and droppings.

3.05 PROTECTION

A. Protect mortar after placement in accordance with the product manufacturer's printed instructions.

END OF SECTION

SECTION 03940

CRACK REPAIRS BY EPOXY INJECTION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Structural repair of cracks in concrete by permanently rebonding the concrete with epoxy resin adhesive injected under pressure with special equipment.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Concrete Rehabilitation: Section 03930.

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:
 - a. Submit reports for tests specified under Source Quality Control.
 - b. If requested, submit test reports for all specified characteristics and properties of the epoxy adhesive materials from an Independent Testing Laboratory.
 - 2. Certificates: Affidavit required under QUALITY ASSURANCE Article.
 - 3. Installation Contractor's Qualifications Data:
 - a. Firm name, address, and telephone number.
 - b. Period of time firm has performed crack repairs by epoxy injection.
 - 4. 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

- A. 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.
 - a. 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.
- B. 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.
- C. 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.
- D. 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.
- E. 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.
- F. 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.

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.
 - a. Viscosity at 40 + 3 degrees F, cps (Brookfield RVT Spindle No. 4 at 20 rpm): 6,000 - 8,000.
 - b. Viscosity at 77 + 3 degrees F, cps (Brookfield RVT Spindle No. 2 at 20 rpm): 300 - 700.
 - c. Epoxide Equivalent Weight (ASTM D 1652): 160 - 220.
 - d. Ash Content, percent (ASTM D 482): 1 maximum.
 2. Hardener: Blend of amine curing agents.
 - a. Viscosity at 40 + 3 degrees F, cps (Brookfield RVT Spindle No. 2 at 20 rpm): 700 - 1,400.
 - b. Viscosity at 77 + 3 degrees F, cps (Brookfield RVT Spindle No. 2 at 20 rpm): 100 - 400.
 - c. Amine Value, mg KOH/g (ASTM D 664): 490 - 560.
 - d. 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:
 - a. 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:
 - a. Ultimate Tensile Strength, psi (ASTM D 638): 5,000 minimum.
 - b. Tensile Elongation at Break, percent (ASTM D 638): 4 maximum.
 - c. Flexural Strength, psi (ASTM D 790): 10,000 minimum.
 - d. Compressive Yield Strength, psi (ASTM D 695): 10,000 minimum.
 - e. Slant Shear Strength, psi (AASHTO T 237, 5,000 psi compressive strength concrete):
 - 1) Cured 3 days at 40 + 3 degrees F, wet/wet concrete: 3,500 minimum.
 - 2) Cured 7 days at 40 + 3 degrees F, wet/wet concrete: 4,000 minimum.
 - 3) 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 Director's 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 Director's Representative.
- E. Records of Tests: Record the date and results of all tests, and furnish a copy of the test records to the Director's Representative.

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

THIS PAGE INTENTIONALLY LEFT BLANK

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, whichever 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

SECTION 04810

UNIT MASONRY

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes unit masonry assemblies consisting of the following:
 - 1. Concrete masonry units (CMUs).
 - 2. Mortar and grout.
 - 3. Steel reinforcing bars.
 - 4. Masonry joint reinforcement.
 - 5. Miscellaneous masonry accessories.
 - 6. All hoisting and scaffolding for completion of masonry work.
 - 7. Masonry waste disposal.
- B. Related Sections include the following:
 - 1. Division 7 Section "Joint Sealants" for sealing control and expansion joints in unit masonry.
 - 2. Division 8 Section "Door Hardware."

1.03 DEFINITIONS

- A. CMU(s): Concrete masonry unit(s).
- B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.04 PERFORMANCE REQUIREMENTS

- A. Provide unit masonry that develops indicated net-area compressive strengths (f'_m) at 28 days.
- B. Determine net-area compressive strength (f'_m) of masonry from average net-area compressive strengths of masonry units and mortar types (unit-strength method) according to Tables 1 and 2 in ACI 530.1/ASCE 6/TMS 602.

1.05 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For the following:
 - 1. Reinforcing Steel: Detail bending and placement of unit masonry reinforcing bars. Comply with ACI 315, "Details and Detailing of Concrete Reinforcement." Show elevations of reinforced walls.
 - 2. Control/Expansion Joints: Prior to installation, provide layout indicating recommended locations of all control/expansion joints in CMU walls and exterior masonry veneer. Provide details for all conditions.
 - a. Architect will make final determination for locations of all control/expansion joints.
- C. Samples for Verification: For each type and color of the following:
 - 1. Accessories embedded in masonry.

1.06 INFORMATIONAL SUBMITTALS

- A. List of Materials Used in Constructing Mockups: List generic product names together with manufacturers, manufacturers' product names, model numbers, lot numbers, batch numbers, source of supply, and other information as required to identify materials used. Include mix proportions for mortar and grout and source of aggregates.
 - 1. Submittal is for information only. Neither receipt of list nor approval of mockup constitutes approval of deviations from the Contract Documents unless such deviations are specifically brought to the attention of Architect and approved in writing.
- B. Qualification Data: For testing agency.
- C. Material Certificates: Include statements of material properties indicating compliance with requirements including compliance with standards and type designations within standards. Provide for each type and size of the following:
 - 1. Masonry units.
 - a. Include material test reports substantiating compliance with requirements.
 - b. For masonry units used in structural masonry, include data and calculations establishing average net-area compressive strength of units.
 - 2. Cementitious materials. Include brand, type, and name of manufacturer.

3. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
 4. Grout mixes. Include description of type and proportions of ingredients.
 5. Reinforcing bars.
 6. Joint reinforcement.
 7. Anchors, ties, and metal accessories.
- D. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.
1. Include test reports, per ASTM C 780, for mortar mixes required to comply with property specification.
 2. Include test reports, per ASTM C 1019, for grout mixes required to comply with compressive strength requirement.
- E. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area compressive strength of masonry determined according to Tables 1 and 2 in ACI 530.1/ASCE 6/TMS 602.
- F. Cold-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with cold-weather requirements in ACI 530.1.
- G. Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with hot-weather requirements in ACI 530.1.

1.07 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency qualified according to ASTM C 1093 for testing indicated, as documented according to ASTM E 548.
- B. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, through one source from a single manufacturer for each product required.
- C. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from a single manufacturer for each cementitious component and from one source or producer for each aggregate.
- D. Preconstruction Testing Service: Owner will engage a qualified independent testing agency to perform preconstruction testing indicated below. Payment for these services will be made by Owner. Retesting of materials that fail to meet specified requirements shall be done at Contractor's expense.
1. Mortar Test (Property Specification): For each mix required, per ASTM C 780.
 2. Grout Test (Compressive Strength): For each mix required, per ASTM C 1019.

- E. Fire-Resistance Ratings: Where indicated, provide materials and construction identical to those of assemblies with fire-resistance ratings determined per ASTM E 119 by a testing and inspecting agency, by equivalent concrete masonry thickness, or by other means, as acceptable to authorities having jurisdiction.
- F. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Build mockup of typical wall area as directed by Architect.
 - 2. Clean one-half of exposed faces of mockups with masonry cleaner as indicated.
 - 3. Protect accepted mockups from the elements with weather-resistant membrane.
 - 4. Approval of mockups is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; and aesthetic qualities of workmanship.
 - a. Approval of mockups is also for other material and construction qualities specifically approved by Architect in writing.
 - b. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless such deviations are specifically approved by Architect in writing.
 - 5. Demolish and remove mockups when directed by the Architect.
- G. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Meetings."

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.
- B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
- D. Deliver preblended, dry mortar mix in moisture-resistant containers designed for lifting and emptying into dispensing silo. Store preblended, dry mortar mix in delivery containers on elevated platforms, under cover, and in a dry location or in a metal dispensing silo with weatherproof cover.
- E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.09 PROJECT CONDITIONS

- A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
1. Extend cover a minimum of 24 inches down both sides and hold cover securely in place.
 2. Where 1 wythe of multiwythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches down face next to unconstructed wythe and hold cover in place.
- B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least 3 days after building masonry walls or columns.
- C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
 2. Protect sills, ledges, and projections from mortar droppings.
 3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
 4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.
- D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602/1.8C whenever the following conditions exist:
1. The ambient temperature falls below 40 deg F.
 2. The temperature of masonry units is below 40 deg F.
 3. Implement the following minimum procedures:
 - a. The temperature of masonry units shall not be less than 20 deg F when laid in the masonry. Remove visible ice on masonry units prior to installation.
 - b. Heat the mortar sand or mixing water to produce mortar temperatures between 40 deg F and 120 deg F at the time of mixing. Maintain mortar above 32 deg F until used in masonry.
 - c. Use heat sources where ambient temperatures are between 20 deg F and 25 deg F on both sides of the masonry under construction. Install wind breaks when wind velocity is in excess of 15 mph.

- d. Where ambient temperature is below 20 deg F, provide an enclosure for the masonry under construction and use heat sources to maintain temperature above 32 deg F within the enclosure.
 - e. Where mean daily temperatures are between 32 deg F and 40 deg F, protect completed masonry from rain and snow by covering with a weather resistive membrane for 24 hours after construction.
 - f. Where mean daily temperatures are between 25 deg F and 32 deg F, completely cover completed masonry with a weather resistive membrane for 24 hours after construction.
 - g. Where mean daily temperatures are between 20 deg F and 25 deg F, completely cover completed masonry with insulating blankets, or equal protection, for 24 hours after construction.
 - h. Where mean daily temperatures are below 20 deg F, maintain masonry temperature above 32 deg F for 24 hours after construction by enclosure with supplementary heat, by electric blankets, by infrared heat lamps, or other acceptable methods.
- 4. Do not lay masonry units that are wet or frozen.
 - 5. Remove masonry damaged by freezing conditions.
 - 6. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and above and will remain so until masonry has dried, but not less than 7 days after completing cleaning.
- E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602/1.8D, whenever the ambient air temperature exceeds the following:
- 1. 100 deg F, or 90 deg F with a wind velocity greater than 8 mph.
 - 2. Implement hot weather protection in accordance with Article 2.1.2.1(d).
 - 3. Do not spread mortar beds more than 4 feet ahead of masonry. Set masonry units within one minute of spreading mortar.

PART 2 - PRODUCTS

2.01 MASONRY UNITS, GENERAL

- A. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to exceed tolerances and to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not use units where such defects, including dimensions that vary from specified dimensions by more than stated tolerances, will be exposed in the completed Work or will impair the quality of completed masonry.

2.02 CONCRETE MASONRY UNITS (CMUs)

A. Shapes: Provide shapes indicated and as follows:

1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions where indicated.
2. Provide factory fabricated bullnose units for outside corners, except for the following locations:
 - a. Door or passage openings in masonry walls.

B. Concrete Masonry Units: ASTM C 90.

1. Products: Subject to compliance with requirements, provide products by one of the following:
 - a. A. Jandris & Sons.
 - b. Nitterhouse Masonry Products, LLC.
 - c. Westbrook Block, Inc.
2. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 1900 psi.
3. Weight Classification: Lightweight.
4. Size (Width): Manufactured to dimensions 3/8 inch less than nominal dimensions.
5. Exposed Faces: Manufacturer's standard color and texture.
6. Fire Rated Concrete Masonry: In accordance with test procedures set forth in ASTM E 199 or alternative methods as follows:
 - a. U.L. Design Assemblies: Provide a U.L. Certificate for design of composite wall assembly for each hourly rating required.
 - b. In accordance with the Massachusetts State Building Code:
 - 1) Fire-resistance designs documented in approved sources.
 - 2) Prescriptive designs of fire-resistant rated building elements as prescribed in Section 720.0.
 - 3) Calculations in accordance with Section 721.0.
 - 4) Engineering analysis based on a comparison of building element designs having fire resistance ratings as determined by test procedures set forth in ASTM E 119.
 - c. Fire rated wall construction includes reinforcement, facing or finish materials, load bearing and non-load bearing walls; and requirements for members framed into walls.

2.03 MASONRY LINTELS

- A. General: Provide masonry lintels as indicated, complying with requirements below.
- B. Masonry Lintels: Built-in-place masonry lintels made from lintel and/or bond beam concrete masonry units with reinforcing bars placed as indicated and filled with coarse grout. Temporarily support built-in-place lintels until cured.
 - 1. Grouted cells shall not be visible on the underside of masonry lintels.

2.04 MORTAR AND GROUT MATERIALS

- A. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.
- B. Hydrated Lime: ASTM C 207, Type S.
- C. Portland Cement-Lime Mix: Packaged blend of portland cement complying with ASTM C 150, Type I or Type III, and hydrated lime complying with ASTM C 207, Type S.
- D. Masonry Cement: The use of masonry cement is not permitted.
- E. Aggregate for Grout: ASTM C 404.
- F. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C 494/C 494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Euclid Chemical Company (The); Accelguard 80.
 - b. GCP Applied Technologies; Morset.
 - c. RussTech; Mortarset-NC.
- G. Water: Potable.

2.05 MORTAR AND GROUT MIXES

- A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated.
 - 1. Do not use calcium chloride in mortar or grout.

2. Limit cementitious materials in mortar to portland cement and lime.
 3. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.
- B. Mortar Mixes: At Contractor's option, provide job-mixed mortar or preblended dry mortar mix. Provide colors required for each application indicated.
- C. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.
1. Product: Subject to compliance with requirements, provide the following, or equal:
 - a. Spec Mix; Portland Lime & Sand.
- D. Mortar Types for Unit Masonry: Comply with ASTM C 270, Proportion Specification. Provide the following types of mortar for applications stated:
1. For reinforced masonry, use Type M.
- E. Grout for Unit Masonry: Comply with ASTM C 476.
1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 1.15.1 in ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.
 - a. Use fine grout for 6 inch thick concrete masonry wythes.
 - b. Use course grout for 8-inch thick or greater concrete masonry wythes.
 2. Proportion grout in accordance with ASTM C 476, Table 1 or paragraph 4.2.2 for specified 28-day compressive strength indicated, but not less than 2000 psi.
 3. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C 143.

2.06 REINFORCING STEEL

- A. Uncoated Steel Reinforcing Bars: ASTM A 615/A 615M or ASTM A 996/A 996M, Grade 60.

2.07 MASONRY JOINT REINFORCEMENT

- A. Masonry Joint Reinforcement, General: ASTM A 951.
1. Exterior Walls: Hot-dip galvanized, carbon steel.

2. Wire Size for Side Rods: W1.7 or 0.148-inch diameter (9 gauge).
 3. Wire Size for Cross Rods: W1.7 or 0.148-inch diameter (9 gauge).
 4. Wire Size for Veneer Ties: W2.8 or 0.188-inch diameter (3/16-inch).
 5. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches o.c.
 6. Provide in lengths of not less than 10 feet, with prefabricated corner and tee units.
- B. Masonry Joint Reinforcement for Single-Wythe Masonry: Ladder type with single pair of side rods.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Heckmann Building Products; Ladder Type 1100.
 - b. Hohmann & Barnard, Inc.; #220 Ladder Mesh.
 - c. Wire-Bond; Series 200 Core Clear Ladder Type.

2.08 MISCELLANEOUS ANCHORS

- A. Unit Type Inserts in Concrete: Cast-iron or malleable-iron wedge-type inserts.
- B. Anchor Bolts: Headed steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers; hot-dip galvanized to comply with ASTM A 153/A 153M, Class C; of dimensions indicated.

2.09 MISCELLANEOUS MASONRY ACCESSORIES

- A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene.
 1. Control Joints: Provide compressible filler, 3/8-inch thick and 3 inches wide.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) Heckmann Building Products; Neoprene Expansion Joints 354.
 - 2) Hohmann & Barnard, Inc.; NS Closed Cell Neoprene Sponge.
 - 3) Wire-Bond; #3300 Expansion Joint.
 2. Premolded Joint Filler at Steel Columns: Provide compressible filler as indicated for Control Joints.
- B. Preformed Control-Joint Gaskets: Made from PVC, complying with ASTM D 2287, Type PVC-65406 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Blok-Lok; VS Series PVC Control Joint.
 - b. Hohmann & Barnard, Inc.; #VS Series – PVC Control Joint.
 - c. Wire-Bond; PVC Control Joint.

- C. Bond-Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).

- D. Grout Screen: Fabricated from monofilament polypropylene mesh to prevent grout falling through; without interfering with mortar bond.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Heckmann Building Products, Inc.; Grout Stop.
 - b. Hohmann & Barnard, Inc.; MGS.
 - c. Wire-Bond; Grout Stop 3612.

- E. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells with loops for holding reinforcing bars in center of cells. Units are formed from 0.148-inch (9 gauge) steel wire, hot-dip galvanized after fabrication. Provide units with either two loops or four loops as needed for number of bars indicated.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Heckmann Building Products Inc.; No. 376 Rebar Positioner.
 - b. Hohmann & Barnard, Inc.; #RB or #RB-Twin Rebar Positioner.
 - c. Wire-Bond; O-Ring or Double O-Ring Rebar Positioner.

2.10 MASONRY CLEANERS

- A. Detergent Solution, Job Mixed: Solution prepared by mixing 2 cups of tetrasodium pyrophosphate (TSP), 1/2 cup of laundry detergent, and 20 quarts of hot water for every 5 gal. of solution required.

- B. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Diedrich Technologies, Inc.

- b. ProSoCo, Inc.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.
 - 1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.
 - 2. Verify that foundations are within tolerances specified.
 - 3. Verify that reinforcing dowels are properly placed.
- B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION, GENERAL

- A. Thickness: Build single-wythe walls to actual widths of masonry units, using units of widths indicated.
- B. Build chases and recesses to accommodate items specified in this and other Sections.
- C. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to opening.
- D. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.
- E. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures.
 - 1. Mix units from several pallets or cubes as they are placed.

3.03 TOLERANCES

- A. Dimensions and Locations of Elements:

1. For dimensions in cross section or elevation do not vary by more than plus 1/2 inch or minus 1/4 inch.
 2. For location of elements in plan do not vary from that indicated by more than plus or minus 1/2 inch.
 3. For location of elements in elevation do not vary from that indicated by more than plus or minus 1/4 inch in a story height or 1/2 inch total.
- B. Comply with construction tolerances in ACI 530.1/ASCE 6/TMS 602 and with the following:
1. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
 2. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet, or 1/2 inch maximum.
 3. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
 4. For exposed bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch. Do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.
 5. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch. Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch.
 6. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch except due to warpage of masonry units within tolerances specified for warpage of units.
 7. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than 1/16 inch from one masonry unit to the next.

3.04 LAYING MASONRY WALLS

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.
1. Lay out masonry walls first with snap lines on the concrete slab . Once line layout is complete, lay out concrete masonry units dry (without mortar) in a single course on the concrete slab to verify coursing, reinforcement, and necessary masonry cuts.
- B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in the following bond pattern(s); do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.

1. Running bond.
- C. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 2-inches. Bond and interlock each course of each wythe at corners. Do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.
 - D. Stopping and Resuming Work: Stop work by racking back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar before laying fresh masonry.
 - E. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.
 - F. Fill space between steel frames and masonry solidly with mortar, unless otherwise indicated.
 - G. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below and rod mortar or grout into core.
 - H. Fill all cores in hollow concrete masonry units with grout.

3.05 MORTAR BEDDING AND JOINTING

- A. Lay concrete masonry units as follows:
 1. With face shells fully bedded in mortar and with head joints of depth equal to bed joints.
 2. With webs fully bedded in mortar in all courses of piers, columns, and pilasters.
 3. With webs fully bedded in mortar in grouted masonry, including starting course on footings.
 4. With entire units, including areas under cells, fully bedded in mortar at starting course on footings where cells are not grouted.
- B. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.
- C. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness, unless otherwise indicated.
 1. Strike mortar joints flush where providing substrate for fluid applied air and vapor barrier at interior cavity wall masonry wythes.

3.06 MASONRY JOINT REINFORCEMENT

- A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcement a minimum of 6 inches.
 - 1. Space reinforcement not more than 16 inches o.c.
 - 2. Space reinforcement not more than 8 inches o.c. in foundation walls and parapet walls.
 - 3. Provide reinforcement not more than 8 inches above and below wall openings and extending 12 inches beyond openings.
 - a. Reinforcement above is in addition to continuous reinforcement.
- B. Interrupt joint reinforcement at control and expansion joints, unless otherwise indicated.
- C. Corners: Provide interlocking masonry unit bond in each wythe and course at corners unless otherwise indicated.
 - 1. Provide continuity with masonry-joint reinforcement at corners by using prefabricated L-shaped units as well as masonry bonding.
- D. Intersecting and Abutting Walls: Unless vertical expansion or control joints are shown at juncture, bond walls together as follows:
 - 1. Provide continuity with masonry-joint reinforcement by using prefabricated T-shaped units.

3.07 CONTROL AND EXPANSION JOINTS

- A. General: Install control and expansion joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.
- B. Form control joints in concrete masonry as follows:
 - 1. Fit bond-breaker strips into hollow contour in ends of concrete masonry units on one side of control joint. Fill resultant core with grout and rake out joints in exposed faces for application of sealant.
 - 2. Install control joints in interior concrete masonry partitions where indicated, and as follows. During wall layout, verify locations of all control joints with Architect.
 - a. Spacing of control joints in straight walls not to exceed 20 feet horizontally.
 - b. Install control joints at intersections of walls and column enclosures.

3.08 LINTELS

- A. Provide masonry lintels at openings in exterior CMU partitions.
- B. Provide minimum bearing of 8 inches at each jamb, unless otherwise indicated.

3.09 REINFORCED UNIT MASONRY INSTALLATION

- A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.
 - 1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
 - 2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other temporary loads that may be placed on them during construction.
- B. Placing Reinforcement: Comply with requirements in ACI 530.1/ASCE 6/TMS 602.
- C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.
 - 1. Do not exceed the following pour heights for fine grout.
 - a. For minimum widths of grout spaces of 3/4 inch or for minimum grout space of hollow unit cells of 1-1/2 by 2", pour height of 12".
 - b. For minimum widths of grout spaces of 2" or for minimum grout space of hollow unit cells of 2 by 3", pour height of 60".
 - c. For minimum widths of grout spaces of 2-1/2" or for minimum grout space of hollow unit cells of 2-1/2 by 3", pour height of 12 feet.
 - d. For minimum widths of grout spaces of 3" or for minimum grout space of hollow unit cells of 3 by 3" pour height of 24 feet.
 - 2. Do not exceed the following pour heights for coarse grout:
 - a. For minimum widths of grout spaces of 1-1/2" or for minimum grout space of hollow unit cells of 1-1/2 by 3", pour height of 12 inches.
 - b. For minimum widths of grout spaces of 2 inches or for minimum grout space of hollow unit cells of 2-1/2 by 3", pour height of 60 inches.
 - c. For minimum widths of grout spaces of 2-1/2" or for minimum grout space of hollow unit cells of 3 by 3", pour height of 12 feet.
 - d. For minimum widths of grout spaces of 3" or for minimum grout space of hollow unit cells of 3 by 4 inches, pour height of 24 feet.

3. Provide cleanout holes at least 3” in least dimension for grout pours over 60 inches in height.
 - a. Provide cleanout holes at each vertical reinforcing bar.
 - b. At solid grouted masonry, provide cleanout holes at not more than 32 inches o.c.
- D. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other temporary loads that may be placed on them during construction.

3.10 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Owner will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas, as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.
- B. Inspections: Special inspections according to the Massachusetts State Building Code.
 1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.
 2. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.
- C. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections indicated below and prepare test reports:
 1. Payment for these services will be made by Owner.
 2. Retesting of materials failing to comply with specified requirements shall be done at Contractor's expense.
- D. Testing Frequency: One set of tests for each 5000 sq. ft. of wall area or portion thereof.
- E. Mortar Test (Property Specification): For each mix provided, per ASTM C 780. Test mortar for compressive strength.
- F. Grout Test (Compressive Strength): For each mix provided, per ASTM C 1019.

3.11 REPAIRING, POINTING, AND CLEANING

- A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.

- B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.
- C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.
- D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
 - 1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
 - 2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
 - 3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
 - 4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
 - 5. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.
 - 6. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2A applicable to type of stain on exposed surfaces.

3.12 MASONRY WASTE DISPOSAL

- A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.
 - 1. Disposal: Separate, salvage, recycle and dispose of materials in accordance with the Commonwealth of Massachusetts "Waste Ban" 310 CMR 19.017.

END OF SECTION

DIVISION 05

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 05120

STRUCTURAL STEEL FRAMING

PART 1 GENERAL

1.01 DESCRIPTION OF WORK

1. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section of the Specifications.
 - a. Structural Steel.
 - b. Architecturally exposed structural steel.
2. Related Work: The following items are not included in this Section and will be performed under the designated Sections:
 - a. Section 05500 – METALS FABRICATION

1.02 DEFINITIONS

Structural Steel: Elements of structural-steel frame, as classified by AISC's "Code of Standard Practice for Steel Buildings and Bridges", that support design loads.

- A. Architecturally Exposed Structural Steel: Structural steel that forms a prominent architectural feature in a building or structure or designated as architecturally exposed structural steel on the Drawings.

1.03 PERFORMANCE REQUIREMENTS

Connections: Provide details of connections required by the Contract Documents to be selected or completed by the structural-steel fabricator to withstand loads indicated and comply with other information and restrictions indicated.

Select and complete connections using the American Institute of Steel Construction's (AISC) "Manual of Steel Construction, Load and Resistance Factor Design", Volume 2, Part 9.

Engineering Responsibility: Fabricator's responsibilities include using a qualified professional engineer to prepare structural analysis data for structural-steel connections.

1.04 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show fabrication of structural-steel components.
 1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
 2. Include embedment drawings.
 3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length and type of each weld.

4. Indicate type, size and length of bolts, distinguishing between shop and field bolts. Identify pre-tensioned and slip-critical high-strength bolted connections.
 5. For structural-steel connections indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- C. Welding Certificates: Certificate from AWS indicating certification in type of welding required for each welder and welding operator.
- D. Welding Records and Data:
1. Before welding, submit the procedure which will be used for qualifying welders and welding procedures. For procedures other than those pre-qualified in accordance with AWS D1.1, submit a copy of procedure qualification test records.
 2. Submit certified copy of qualification test records for each welder, welding operator, and tacker who will be employed in the work.
 3. If field welding is permitted, submit descriptive data for field welding equipment.
 4. Submit all NDE records (radiographs, ultrasonic, magnetic particle) and visual inspection reports upon completion or when otherwise requested by the Engineer.
- E. Qualification Data: For installer, fabricator, professional engineer, testing agency, welding inspectors, NDE inspectors and galvanizer. Submit prior to starting work.
- F. Mill Test Reports: Signed by manufacturers certifying that the following products comply with requirements:
1. Structural steel including chemical and physical properties.
 2. Bolts, nuts, and washers including mechanical properties and chemical analysis.
 3. Direct-tension indicators.
 4. Tension-control, high-strength bolt-nut-washer assemblies.
 5. Shear stud connectors.
 6. Shop primers.
 7. Nonshrink grout.

1.05 QUALITY ASSURANCE

- A. Fabricator Qualifications: A qualified fabricator who participates in the AISC Quality Certification Program and is certified for: Steel Building Structures (STD).
- B. Galvanizer Qualifications: Engage the services of a qualified galvanizer who has demonstrated a minimum of five years experience in the successful application of galvanized coatings specified in this Section in the facility where the work is to be performed and who will apply the coatings within the same facility.
- C. Installer Qualifications: A qualified installer with previous experience in installing structural steel.

D. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel".

E. Comply with applicable provisions of the following specifications and documents:

1. AISC's "Code of Standard Practice for Steel Buildings and Bridges"
2. AISC's "Seismic Provisions for Structural Steel Buildings" and "Supplement No. 2"
3. AISC's "Specification for Structural Steel Buildings--Allowable Stress Design and Plastic Design" and "Load and Resistance Factor Design Specification for Structural Steel Buildings"
4. AISC's "Specification for the Design of Steel Hollow Structural Sections"
5. AISC's "Specification for Allowable Stress Design of Single-Angle Members" and "Specification for Load and Resistance Factor Design of Single-Angle Members"
6. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts"

F. Tests and Inspection

1. The Contractor will test and inspect high-strength bolted connections and welded connections and prepare test reports. Specialty tests shall be performed at no expense to the Owner by an independent testing laboratory approved by the Engineer. Costs of specialty tests shall be borne by the Contractor. Test reports shall be submitted to the Engineer for approval.
2. The Engineer reserves the right to inspect high-strength bolted connections and weld connections. Provide access to places where structural steel work is being fabricated or erected so that required inspection and testing can be accomplished at no change in Contract Price. At times, inspection may require moving or handling of steel to permit proper inspection. Notify Materials Testing Laboratory not less than 48 hours prior to start of fabrication.
3. The Engineer may inspect structural steel at the plant before shipment; however, the Engineer reserves the right, at any time before final acceptance, to reject material not complying with specified requirements.
4. Correct deficiencies in structural steel work that inspections and laboratory test reports have indicated to be not in compliance with requirements at the Contractor's expense. Perform additional tests, at no expense to the Owner, as may be necessary to reconfirm any non-compliance of the original work, and as may be necessary to show compliance of corrected work.
5. Specialty Tests: Nondestructive examination of welds in accordance with provisions of AWS D1.1 and ASTM Standards noted shall be made in accordance with the following schedule:
 - a. Radiographic Examination of Welds, per ASTM E94 and E142:
 - 1) Field, complete joint penetration groove welds:
 - a. 1 out of 5 (20 percent) with thickness equal to or less than 3/4 inch.
 - b. 100 percent with thickness greater than 3/4 inch.

- 2) Shop, complete joint penetration groove welds:
 - a. 1 out of 10 (10 percent) with thickness equal to or less than 3/4 inch.
 - b. 1 out of 2 (50 percent) with thickness greater than 3/4 inch and equal to or less than 1-1/2 inches.
 - c. 100 percent for thickness greater than 1-1/2 inches.

 - b. Ultrasonic Examination, per ASTM E164: Complete joint penetration groove butt welds not accessible for radiographic examination shall be subjected to ultrasonic testing. The extent shall be the same as noted for radiographic examination. Ultrasonic examination shall be made 48 to 72 hours after welding at locations on weldments or welded joints subject to high restraint as indicated in order to check for lamellar tearing. The exact location of the areas to be inspected shall be determined with the Engineer at the time of fabrication. This examination shall be made according to the following schedule unless conditions of tearing require a greater number of tests, as directed:
 - 1) 1 out of 10 (10 percent) for thickness equal to or less than 3/4 inch.
 - 2) 1 out of 5 (20 percent) for thickness greater than 3/4 inch and equal to or less than 1-1/4 inches.
 - 3) 1 out of 2 (50 percent) for thickness greater than 1-1/4 inches.

 - c. Magnetic Particle Examination, per ASTM E709, field and shop:
 - 1) 1 out of 5 (20 percent) of complete joint penetration groove welds of tee and corner joints.
 - 1) 1 out of 10 (10 percent) of partial joint penetration groove and fillet welds.

 - d. Penetrant Examination, per ASTM E165: Shall be used for detecting discontinuities that are open to the surface use as appropriate.
6. Visual Examination: All welds whether otherwise examined or not shall be visually examined and faulty joints shall be marked for correction.
 7. When any testing, examination or inspection reveals faulty welds, all joints of the same type shall be checked at no expense to the Owner until the integrity of the weld is assured before resuming examination.
 8. After faulty welds have been corrected or repaired, they shall each be re-examined at no expense to the Owner in the manner specified for the original joint.
 9. It is intended that inspections shall be performed to permit an orderly flow of completed material from the shop. Work with the Engineer to establish a schedule that will permit this.
 10. Test result information shall be forwarded to the Engineer immediately after test results are available stating the acceptance or rejection of fabricated pieces in order that the repairs and re-inspection may be made as soon as possible.
- G. Pre-Installation Conference: Contractor shall schedule a meeting to be attended by Contractor, Engineer, fabricator and galvanizer. Agenda shall include the following: Project schedule, source for each fabrication, coordination between fabricator and galvanizer and adjacent Work, finish of surfaces, application of coatings, submittals, and approvals.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from erosion and deterioration.
 - 1. Store fasteners in a protected place. Clean and re-lubricate bolts and nuts that become dry or rusty before use.
 - 2. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

1.07 COORDINATION

- A. Furnish anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions and directions for installation.

PART 2 – PRODUCTS

2.01 STRUCTURAL-STEEL MATERIALS

- A. S-Shapes, W-Shapes: ASTM A 992, Grade 50.
- B. Channels, Angles, Plates and Bar: ASTM A 36.
- C. Cold-Formed Hollow Structural Sections: ASTM A 500, Grade B, structural tubing.
- D. Steel Pipe: ASTM A 53, Type E or S, Grade B.
- E. Medium-Strength Steel Castings: ASTM A 27, Grade 65-35 carbon steel.
- F. High-Strength Steel Castings: ASTM A 148, Grade 80-50, carbon or alloy steel.
- G. Welding Electrodes: Comply with AWS requirements.

2.02 BOLTS, CONNECTORS, AND ANCHORS

- A. High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy hex steel structural bolts; ASTM A 563 heavy hex carbon-steel nuts; and ASTM F 436 hardened carbon-steel washers.
 - 1. Finish: Hot-dip zinc coating, ASTM A 153, Class C.
- B. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 1, steel structural bolts with splined ends; ASTM A 563 heavy hex carbon-steel nuts; and ASTM F 436 hardened carbon-steel washers. Finish, mechanically deposited zinc coating, ASTM B 695, Class 50.
- C. Shear Connectors: ASTM A 108, Grades 1015 through 1020, headed-stud type, cold-finished carbon steel; AWS D1.1, Type B.

- D. Anchor Rods: ASTM F 1554, grade as applicable, hot-dip zinc coating, ASTM A 153, Class C.
- E. Threaded Rods: ASTM A 193, grade as applicable, hot-dip zinc coating, ASTM A 153, Class C.
- F. Eye Bolts and Nuts: ASTM A 108, Grade 1030, cold-finished carbon steel.
- G. Sleeve Nuts: ASTM A 108, Grade 1018, cold-finished carbon steel.

2.03 MISCELLANEOUS MATERIALS

- A. Galvanizing Repair Paint: Coatings meeting requirements of ASTM A 780.
- B. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.04 FABRICATION

- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and AISC's "Specification for Structural Steel Buildings--Allowable Stress Design and Plastic Design".
 - 1. Camber structural-steel members where indicated.
 - 2. Identify high-strength structural steel according to ASTM A 6/ A 6M and maintain markings until structural steel has been erected.
 - 3. Mark and match-mark materials for field assembly.
 - 4. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.
- B. Architecturally Exposed Structural Steel: Comply with fabrication requirements, including tolerance limits, of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for structural steel identified as architecturally exposed structural steel.
 - 1. Fabricate with exposed surfaces smooth, square, and free of surface blemishes including pitting, rust, scale, seam marks, roller marks, rolled trade names, and roughness.
 - 2. Remove blemishes by filling or grinding or by welding and grinding, before cleaning, treating, and shop priming.
- C. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1.
- D. Bolt Holes: Cut, drill, or punch standard bolt holes perpendicular to metal surfaces.
- E. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.
- F. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1 and manufacturer's written instructions.

- G. Steel Wall-Opening Framing: Select true and straight members for fabricating steel wall-opening framing to be attached to structural steel. Straighten as required to provide uniform, square, and true members in completed wall framing.
- H. Welded Door Frames: Build up welded door frames attached to structural steel. Weld exposed joints continuously and grind smooth. Plug-weld fixed steel bar stops to frames. Secure removable stops to frames with countersunk, cross-recessed head machine screws, uniformly spaced not more than 10 inches o.c., unless otherwise indicated.
- I. Holes: Provide holes required for securing other work to structural steel and for passage of other work through steel framing members.
 - 1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
 - 2. Base-Plate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
 - 3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.05 SHOP CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
- B. Weld Connections: Comply with AWS D1.1 for welding procedure specifications, tolerances, appearance, and quality of welds and for methods used in correcting welding work. Complete welds in accordance with the Contract Drawings.
 - 1. Remove backing bars or runoff tabs, back gouge, and grind steel smooth.
 - 2. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for mill material.
 - 3. Insufficient welds shall be rejected and corrected until required profiles are met.
 - 4. Verify that weld sizes, fabrication sequence, and equipment used for architecturally exposed structural steel will limit distortions to allowable tolerances. Prevent weld show-through on exposed steel surfaces.
 - a. Grind butt welds flush.
 - b. Grind or fill exposed fillet welds to smooth profile. Dress exposed welds.
 - 5. No skip welds will be permitted for steel connections to be coated.

2.06 STEEL PRIMERS AND FINISHES

- A. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with minimum requirements indicated below for The Society for Protective Coatings (SSPC) surface preparation specifications and environmental exposure conditions of installed metal fabrications:

1. Exteriors (SSPC Zone 1B) and Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 10/NACE No. 2, "Near White Metal Blast Cleaning"
 2. Interiors (SSPC Zone 1A): SSPC-SP 6, "Commercial Blast Cleaning"
 3. Apply shop primer to uncoated surfaces of metal fabrications, except those with galvanized finishes and those to be field welded, embedded in concrete or masonry, unless otherwise indicated. Extend priming of partially embedded members to a depth of 2 inches.
 4. Comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel" for shop painting.
 5. Comply with SSPC-PA 2, "Measurement of Dry Coating Thickness with magnetic Gages"
- B. Zinc-Rich Primer: Urethane zinc rich primer compatible with topcoat Specified in Section 09900. Provide primer with a VOC content of 340 g/L (2.8 lb/gal.) or less per OTC ozone standards. Provide Tnemec Series 394 or Ameron 5105 or equal by DuPont or Carboline for exposed steel to be fireproofed, or Tnemec Series 901K97 Series or 90-97 or Ameron 68HS or equal by DuPont or Carboline for exposed steel to be finish painted at 3.0 mils DFT.
- C. Primer for Exposed Steel to Receive Multi-Coat Shop-Applied Coating: Tnemec Series 901K97 or 90-97 urethane zinc rich primer at 3.0 to 3.5 mils DFT, topcoated in shop with Tnemec Series V73 Endura-Shield, or use Ameron Series 68HS Primer at 3.0 to 5.0 mils DFT topcoated in shop with Ameron's Amercoat 450H, or use or equal primers and finish coats from DuPont or Carboline.
- D. Galvanizing: For steel exposed to the elements, weather or corrosive environments and other steel indicated to be galvanized, provide coating for iron and steel fabrications applied by the hot-dip process. Comply with ASTM A 123 for fabricated products and ASTM A 153 for hardware. Provide thickness of galvanizing specified in referenced standards. The galvanizing bath shall contain high grade zinc and other earthy materials. Fill vent holes and grind smooth after galvanizing.
- E. Hot-Dip Galvanizing And Factory-Applied Primer for Steel: Provide hot-dip galvanizing and factory-applied prime coat, certified OTC/VOC compliant less than 2.8 lbs/gal. and conforming to EPA and Commonwealth of Massachusetts requirements. Apply primer within 12 hours after galvanizing at the galvanizer's plant in a controlled environment meeting applicable environmental regulations and as recommended by the primer coating manufacturer. Blast cleaning of the surface is unacceptable for surface preparation. Primer shall have a minimum two year re-coat window for application of finish coat. Coatings must meet or exceed the following performance criteria:
1. Abrasion: ASTM D 4060, CS17 Wheel, 1,000 gram load.
 2. Adhesion: ASTM D 3359, Method B, 5 mm crosshatch.
 3. Humidity Resistance: ASTM D 4585.
 4. Salt Spray (Fog): ASTM B 117.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments, with steel erector present, for compliance with requirements. Elevations shall be verified by a surveyor licensed in the Commonwealth of Massachusetts.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place, unless otherwise indicated. Do not remove temporary shoring supporting composite deck construction until cast-in-place concrete has attained its design compressive strength.

3.03 ERECTION

- A. Set structural steel accurately in locations and to elevations indicated and according to AISC's "Code of Standard Practice for Steel Buildings and Bridges".
- B. Base and Bearing Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting base and bearing plates. Clean bottom surface of base and bearing plates.
 - 1. Set base and bearing plates for structural members on wedges, shims, or setting nuts as required.
 - 2. Weld plate washers to top of base plate.
 - 3. Snug-tighten or pretension anchor rods as applicable after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of base or bearing plate before packing with grout.
 - 4. Promptly pack grout solidly between bearing surfaces and base or bearing plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.
- C. Maintain erection tolerances of structural steel and architecturally exposed structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges".
- D. Align and adjust various members forming part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
 - 1. Level and plumb individual members of structure.
 - 2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.
- E. Splice members only where indicated.
- F. Remove erection bolts on welded, architecturally exposed structural steel; fill holes with plug welds; and grind smooth at exposed surfaces.

- G. Do not use thermal cutting during erection unless approved by Engineer. Finish thermally cut sections within smoothness limits in AWS D1.1.
- H. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.
- I. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1 and manufacturer's written instructions.

3.04 FIELD CONNECTIONS

- A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint indicated on the Drawings.
- B. Weld Connections: Comply with AWS D1.1 for welding procedure specifications, tolerances, appearance, and quality of welds and for methods used in correcting welding work.
 - 1. Comply with AISC's "Code of Standard Practice for Steel Buildings and Bridges" for bearing, adequacy of temporary connections, alignment, and removal of paint on surfaces adjacent to field welds.
 - 2. Remove backing bars or runoff tabs, back gouge, and grind steel smooth.
 - 3. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for mill material.
 - 4. Verify that weld sizes, fabrication sequence, and equipment used for architecturally exposed structural steel will limit distortions to allowable tolerances. Prevent weld show-through on exposed steel surfaces.
 - a. Grind butt welds flush.
 - b. Grind or fill exposed fillet welds to smooth profile. Dress exposed welds.
 - c. Re-profile all steel surfaces (using needle guns or other profiling methods) that have been welded and ground smooth to assure proper adhesion of primers and topcoats.

3.05 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified independent testing and inspecting agency to inspect field welds and high-strength bolted connections.
- B. Bolted Connections: Bolted connections will be inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts". When using bolted connections prime with "slip critical class B" primer as specified in this Section. All surfaces of bolted or bearing connections may be primed. When welding, hold back primer a minimum of 2 inches each side of weld.
- C. Welded Connections: Field welds will be visually inspected according to AWS D1.1. In addition to visual inspection, specialty tests will be performed in accordance with AWS D1.1 and at the frequency stated in Article 1.5.F.5

- D. In addition to visual inspection, test and inspect field-welded shear connectors according to requirements in AWS D1.1 for stud welding and as follows:
 - 1. Perform bend tests if visual inspections reveal either a less-than- continuous 360-degree flash or welding repairs to any shear connector.
 - 2. Conduct tests on additional shear connectors if weld fracture occurs on shear connectors already tested, according to requirements in AWS D1.1.
- E. Correct deficiencies in Work that test reports and inspections indicate do not comply with the Contract Documents.

3.06 REPAIRS AND PROTECTION

- A. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.
- B. Touchup Painting: After installation, promptly clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted joists and accessories, bearing plates, and abutting structural steel.
 - 1. Clean and prepare surfaces by SSPC-SP 3 power-tool cleaning.
 - 2. Apply a compatible primer of same type as shop primer used on adjacent surfaces.

END OF SECTION

SECTION 05310

STEEL ROOF DECK

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Applicable requirements of Condition of Contract and General Requirements apply to Work specified in this Section.
- B. Work included:
 - 1. Provide steel roof deck.
- C. Related work specified elsewhere:
 - 1. Structural Steel Framing: Section 05120
 - 2. Steel Joists: Section 05210

1.02 QUALITY ASSURANCE

- A. Metal deck shall be designed in accordance with the latest edition of the Steel Deck Institute's (SDI) -- "Specifications and Commentary for Steel Roof Deck."
- B. The roof deck shall be designed, manufactured and installed to meet Factory Mutual Class I construction.

1.03 REFERENCE STANDARDS

- A. AISI -- "Specification for the Design of Cold-Formed Steel Structural Members."
- B. ASTM A36 -- Structural Steel.
- C. ASTM A611 -- Structural Steel, Sheet, Carbon, Cold-Rolled
- D. ASTM A653 -- Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot Dip Process.
- E. AWS D1.1 -- Structural Welding Code.
- F. AWS D1.3 -- Specification for Welding Sheet Steel in Structures.
- G. SDI -- "Design Manual for Composite Decks, Form Decks and Roof Decks."

H. AISC -- Manual of Steel Construction.

I. SDI -- Diaphragm Design Manual.

1.04 SUBMITTALS

A. Submit Shop Drawings for review of general conformance to design concept in accordance with Section 01300. Erection Drawings shall show type of deck, shop finish, accessories, method of attaching, edge details, deck openings and reinforcement, and sequence of installation.

1.05 STORAGE

A. Store materials off ground with one end elevated on wood sleepers to provide drainage. Protect deck from elements with a waterproof covering and ventilate to avoid condensation.

PART 2 PRODUCTS

2.01 MATERIALS

A. Sheet steel shall conform to ASTM A611 Grade C, D or E (for prime painted decks) and ASTM A653, Structural Quality (for galvanized decks) and have a minimum yield strength of 33,000 psi.

B. Bearing Plates and/or Angles shall be ASTM A36 steel.

C. Welding Methods and Materials shall conform to AWS D1.1 and AWS D1.3.

D. Steel Closure Strips, Ridge and Valley Plates, and Related Accessories shall be a minimum of 22 gage sheet steel of required profiles and sizes.

E. Finish:

1. Shop Primer shall be acrylic medium gray.

2. Touch--up primer shall be compatible with manufacturer's primer.

F. Mechanical fasteners shall be Teks as manufactured by Buildex, St. Charles Road, Elgin, Illinois, 60120. Selection of Teks fasteners not specified herein shall be in accordance with the manufacturer's recommendations.

G. Acoustical Insulation shall be glass fiber type with profile to suit decking and be supplied by the deck manufacturer.

2.02 FABRICATION

- A. Steel deck shall have formed ribs of the type, finish, dimension and gage as shown on Drawings.
- B. Fabricate deck in lengths to have three continuous spans or more whenever possible. Fabricate sheets to lap a minimum of 2" over supports at ends. Lap joints required where roof pitch changes due to the deck support elevations.
- C. Design steel decking in accordance with SDI "Design Manual for Composite Decks, Form Decks, and Roof Decks." The maximum working stress shall not exceed 20,000 psi. The maximum working stress shall in no case exceed the maximum yield strength of the steel divided by 1.65 but may be increased by 33% for temporary concentrated loads provided the deck thus required is not less than that required for the specific uniform load. The deflection of the Deck under design live load shall not exceed 1/240 of the span. Minimum thickness of material supplied shall be within 5% of the design thickness.
- D. Section properties used in determining stress and deflection shall be calculated in accordance with the latest edition of the Steel Deck Institute's "Design Manual for Floor Decks and Roof Decks".
- E. Fabricate roof sump pan of 14 gage sheet steel, flat bottom, sloped sides, recessed 1-1/2 inches below roof deck surface, bearing flange 3 inches wide, watertight.
- F. Provide 6" closure strip where changes in deck direction occur. Closure shall be same gauge as deck.

PART 3 EXECUTION

3.01 INSTALLATION

- A. On steel support members provide 1-1/2" minimum bearing. Align and level on supports.
- B. Fasten steel deck units to structural supports using Hex washer head Tekes or arc spot welds according to manufacturers' specifications and erection layouts and as specified herein. Decks thinner than 0.0280 inches shall be welded using 16 ga. welding washers with a 3/8" diameter hole. Side lap connections shall be screwed or button punched depending on deck profile.
- C. Attach ridge and valley plates and steel cant strips directly to the steel deck where shown on the Drawings to provide a finished surface for the application of insulation and roofing.

- D. Cutting of openings through the deck less than 16 square feet in area, and all skew cutting shall be performed in the field.
- E. Arc spot welds (puddle welds) to supports shall have a diameter of 5/8" minimum, or an elongated weld of 3/8" minimum width and 3/4" minimum length. Weld metal shall penetrate all layers of deck material at end laps and have adequate fusion to the supporting members. Welding shall be done in accordance with the American Welding Society Standard "Specification for Welding Sheet Steel in Structures", AWS D1.3.
- F. Fastening of deck to supports and side laps.
 - 1. Deck ends at building perimeter: 12" o/c (36/4 min.)
 - 2. Deck end laps: 12" o/c (36/4 min.)
 - 3. Deck sides at building perimeter and deck side laps: Deck units with spans greater than five feet shall be fastened at midspan or at 36" intervals whichever is smaller.
 - 4. See drawings for requirements beyond these minimum requirements.
- G. At ends of decks or where changes of deck direction occur, fasten at each flute. Furnish and install adequate closures and fasten to both sides at 18" o.c.
- H. Accessories shall be fastened to supports or deck with mechanical fasteners at not over 6" o.c. and at all corners and ends.
- I. Position roof sump pans with flange bearing on top surface of deck. Screw at each deck flute.

3.02 CLEAN UP AND FINAL ADJUSTMENTS

- A. Touch up surface coating damage and abrasions using a paint compatible with primer paint and/or specially formulated for use with galvanized steel.
- B. Installation holes shall be sealed with a closure plate 2 gauges thicker than deck and mechanically fastened to deck. Steel deck with holes visible from below will be rejected. Deck units that are bent, warped, or damaged in any way which would impair the strength and appearance of the deck shall be removed from site.
- C. Steel decking work and accessories, when complete, shall be solid, smooth, and uniform in appearance.
- D. Remove any unused steel deck, edge trimmings, screws, weld washers, butt ends of welding electrodes and other debris from completed installation.

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 05400

COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section Includes:
 - 1. Exterior non-load-bearing wall and soffit framing.
- B. Related Sections include the following:
 - 1. Division 6 Section "Sheathing" for exterior gypsum sheathing.

1.03 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of cold-formed steel framing product and accessory.
- B. Shop Drawings and Calculations:
 - 1. Indicate component details, framed openings, bearing, anchorage, loading, welds, and type and location of fasteners, and accessories or items required of related work.
 - a. Describe method for securing studs to track and for bolted framing connections.
 - b. Provide design engineer's stamp on Shop Drawings, stamped by a professional structural engineer licensed in the Commonwealth of Massachusetts.
 - c. Provide details and calculations for factory-made framing connectors, stamped by a professional structural engineer licensed in the Commonwealth of Massachusetts.

- d. Provide design engineer's stamp on Shop Drawings.
 2. Manufacturer's installation instructions including special procedures and conditions requiring special attention.
 3. Include layout, spacings, sizes, thicknesses, and types of cold-formed steel framing; fabrication; and fastening and anchorage details, including mechanical fasteners.
 4. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.
 5. For load-bearing and non-load-bearing metal framing indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional structural engineer licensed in the Commonwealth of Massachusetts responsible for their preparation.
 6. Include calculations for span capabilities of cold-formed metal framing for deflection and movement criteria specified.
- C. Delegated-Design Submittal: For cold-formed metal framing indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional structural engineer responsible for their preparation, licensed in the Commonwealth of Massachusetts.

1.05 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For professional structural engineer.
- B. Product Test Reports: For each listed product, for tests performed by a qualified testing agency.
 1. Steel sheet.
 2. Expansion anchors.
 3. Power-actuated anchors.
 4. Mechanical fasteners.
 5. Miscellaneous structural clips and accessories.
- C. Research Reports: For non-standard cold-formed steel framing, from ICC-ES.

1.06 QUALITY ASSURANCE

- A. Professional Structural Engineer Qualifications: A professional structural engineer who is legally qualified to practice in the Commonwealth of Massachusetts and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations that are similar to those indicated for this Project in material, design, and extent.

- B. Product Tests: Mill certificates or data from a qualified independent testing agency indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, and metallic-coating thickness.
- C. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 - 2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Protect cold-formed steel framing from corrosion, moisture staining, deformation, and other damage during delivery, storage, and handling.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide cold-formed metal framing by one of the following:
 - 1. ClarkDietrich Building Systems.
 - 2. Marino\WARE.
 - 3. SCAFCO Steel Stud Company.

2.02 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional structural engineer, as defined in Division 1 Section "Quality Control," to design cold-formed steel framing.
- B. Structural Performance: Provide cold-formed steel framing capable of withstanding design loads within limits and under conditions indicated.
 - 1. Design Loads: In accordance with the Massachusetts State Building Code and minimum parameters for calculating design loads for components and cladding indicated on Structural Drawings.
 - 2. Deflection Limits: Design framing systems to withstand design loads without deflections greater than the following:
 - a. Exterior Non-Load-Bearing Framing for Rainscreen Assemblies: Horizontal deflection of 1/360 of the wall height.

3. Design framing systems to provide for movement of framing members located outside the insulated building envelope without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 deg F.
4. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure as follows:
Upward and downward movement of 3/4 inch.
5. Design exterior load-bearing and non-load-bearing wall framing to accommodate lateral building drift and differential foundation settlement as indicated on Structural Drawings.
6. Design exterior load-bearing and non-load-bearing wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.

C. Cold-Formed Steel Framing Design Standards:

1. Wall Studs: AISI S211.
2. Lateral Design: AISI S213.

D. AISI Specifications and Standards: Unless more stringent requirements are indicated, comply with AISI S100 and AISI S200.

2.03 COLD-FORMED STEEL FRAMING, GENERAL

A. Steel Sheet: ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of grade and coating weight as follows:

1. Grade: As required by structural performance.
2. Protective Coating: ASTM A 653/A 653M, G90, hot-dip galvanized.

2.04 EXTERIOR NON-LOAD-BEARING FRAMING

A. Framing Members, General: Comply with ASTM C 754 for conditions indicated.

1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal unless otherwise indicated.
2. Protective Coating: ASTM A 653/A 653M, G90, hot-dip galvanized.

B. Steel Studs: ASTM C 645, manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: 16 gauge minimum, not less than required by structural performance.
2. Flange Width: 1-5/8 inches

- C. Steel Track: ASTM C 645, manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:
 - 1. Minimum Base-Metal Thickness: 16 gauge minimum, not less than required by structural performance.
 - 2. Flange Width: 1-1/4 inches

- D. Single Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal and lateral loads and transfer them to the primary structure, and as follows:
 - 1. Minimum Base-Metal Thickness: As required by structural performance.
 - 2. Flange Width: 1 inch plus the design gap for 1-story structures and 1 inch plus twice the design gap for other applications.

2.05 FRAMING ACCESSORIES

- A. Fabricate steel-framing accessories from steel sheet, ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of same grade and coating weight used for framing members.

- B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:
 - 1. Supplementary framing.
 - 2. Bracing, bridging, and solid blocking.
 - 3. Web stiffeners.
 - 4. Anchor clips.
 - 5. End clips.
 - 6. Foundation clips.
 - 7. Gusset plates.
 - 8. Stud kickers and knee braces.
 - 9. Hole reinforcing plates.
 - 10. Backer plates.

2.06 ANCHORS, CLIPS, AND FASTENERS

- A. Steel Shapes and Clips: ASTM A 36/A 36M, zinc coated by hot-dip process according to ASTM A 123/A 123M.

- B. Anchor Bolts: ASTM F 1554, Grade 36, threaded carbon-steel hex-headed bolts, and carbon-steel nuts; and flat, hardened-steel washers; zinc coated by hot-dip process according to ASTM A 153/A 153M, Class C.

- C. Expansion Anchors: Fabricated from corrosion-resistant materials, with allowable load or strength design capacities calculated according to ICC-ES AC193 and ACI 318 greater than or equal to the design load, as determined by testing per ASTM E 488 conducted by a qualified testing agency.
- D. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with allowable load capacities calculated according to ICC-ES AC70, greater than or equal to the design load, as determined by testing per ASTM E 1190 conducted by a qualified testing agency.
- E. Mechanical Fasteners: ASTM C 1513, corrosion-resistant-coated, self-drilling, self-tapping, steel drill screws.
 - 1. Head Type: Low-profile head beneath sheathing, manufacturer's standard elsewhere.
- F. Welding Electrodes: Comply with AWS standards.

2.07 MISCELLANEOUS MATERIALS

- A. Galvanizing Repair Paint: SSPC-Paint 20 or MIL-P-21035B.
- B. Sealer Gaskets: Closed-cell polyurethane foam, 1/4 inch thick, selected from manufacturer's standard widths to match width of bottom track or rim track members.

2.08 FABRICATION

- A. Fabricate cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.
 - 1. Fabricate framing assemblies using jigs or templates.
 - 2. Cut framing members by sawing or shearing; do not torch cut.
 - 3. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, pneumatic pin fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.
 - a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
 - b. Locate mechanical fasteners and install according to Shop Drawings, with screw penetrating joined members by no fewer than three exposed screw threads.
 - 4. Fasten other materials to cold-formed steel framing by welding, bolting, pneumatic pin fastening, or screw fastening, according to Shop Drawings.

- B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies to prevent damage or permanent distortion.
- C. Fabrication Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:
 - 1. Spacing: Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
 - 2. Squareness: Fabricate each cold-formed steel framing assembly to a maximum out-of-square tolerance of 1/8 inch.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine supporting substrates and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Install sealer gaskets at the underside of wall bottom track.

3.03 INSTALLATION, GENERAL

- A. Install cold-formed steel framing according to AISI S200 and to manufacturer's written instructions unless more stringent requirements are indicated.
- B. Install cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened.
 - 1. Cut framing members by sawing or shearing; do not torch cut.
 - 2. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.
 - a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
 - b. Locate mechanical fasteners and install according to Shop Drawings, and complying with requirements for spacing, edge distances, and screw penetration.

3. Repair G90 coating prior to final installation of member into track.
- C. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.
- D. Install temporary bracing and supports to secure framing and support loads comparable in intensity to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.
- E. Do not bridge building expansion joints with cold-formed steel framing. Independently frame both sides of joints.
- F. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's approved or standard punched openings.
- G. Erection Tolerances: Install cold-formed steel framing level, plumb, and true to line to a maximum allowable tolerance variation as follows:
 1. Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
 2. The following allowable installed tolerances are allowable from locations and dimensions indicated on the Contract Documents and shall not be added to allowable tolerances indicated for other work.
 - a. Allowable variation from true plumb, level and align: 1/8 inch in 20 feet.
 - b. Allowable variation from true wall thickness: 1/8 inch in 20 feet.
 - c. Allowable variation from true plane of adjacent surfaces: 1/8 inch in 10 feet.

3.04 EXTERIOR NON-LOAD-BEARING WALL INSTALLATION

- A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure as indicated.
- B. Fasten both flanges of studs to top and bottom track, and to bottom track only where deflection track is indicated. Space studs as follows:
 1. Stud Spacing: Maximum of 16 inches on center and 12 inches on center for corner zone, not less than that required to resist applied loads.
- C. Set studs plumb, except as needed for diagonal bracing or required for non-plumb walls or warped surfaces and similar requirements.

- D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.
 - 1. Install single deep-leg deflection tracks and anchor to building structure.
- E. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.
 - 1. Install continuous horizontal stiffeners in all walls over 9'-0" in height. stiffeners shall be installed mid height, but no more than 5'-0" o.c. vertically.

3.05 REPAIRS AND PROTECTION

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed steel framing with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.
- B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that cold-formed steel framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION

SECTION 05500
METAL FABRICATIONS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes

1. Requirements to fabricate, furnish, erect, set, fasten and install miscellaneous metalwork as indicated on the Drawings and as specified.

B. Related Sections

1. Section 09900 – Painting

1.02 REFERENCES

A. American Society for Testing and Materials (ASTM)

1. A36, Specification for Carbon Structural Steel.
2. A48, Specification for Gray Iron Castings.
3. A53, Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded Seamless.
4. A123, Specification for Zinc (Hot-Dipped Galvanized) Coatings on Iron and Steel Products.
5. A153, Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
6. A167, Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
7. A276, Specification for Stainless Steel Bars and Shapes.
8. A307, Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
9. A325, Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
10. A489, Specification for Carbon Steel Lifting Eyes.
11. A500, Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
12. A501, Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
13. B209, Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
14. B221, Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
15. B308, Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles.
16. B429, Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.
17. B632, Specification for Aluminum-Alloy Rolled Tread Plate.
18. B660, Standard Practices for Packaging/Packing of Aluminum and Magnesium Products.
19. F436, Specification for Hardened Steel Washers.
20. F468, Specification for Nonferrous Bolts, Hex Cap Screws, Studs for General Use.
21. F593, Specification for Stainless Steel Bolts, Hex Cap Screws and Studs.
22. F594, Specification for Stainless Steel Nuts.
23. F844, Specification for Washers, Steel, Plain (Flat), Unhardened for General Use.

1.03 SUBMITTALS

- A. In accordance with Section 01300 submit the following:

1. Manufacturer's technical data sheets for the following:
 - a. Bitumastic coating.
 - b. Grout.
 - c. Chemical Anchors
2. Shop Drawings:
 - a. Details of the fabrication and erection of each metal fabrication indicated on the Drawings.
 - b. Plans, elevations, sections, and details of metal fabrications and their connections.
 - c. Anchorage and accessory items.
 - d. 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.
3. Welding Certificates: Copies of certificates for welding procedures and personnel.
4. 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:

1. Fabrication Company to be experienced in the production of metal fabrications similar to those indicated for this Project, with a record of successful in-service performance.
2. Fabrication Company to possess sufficient production capacity to produce the work required and complete the work within the duration of the contract.

B. Welding:

1. Procedures and personnel shall be qualified according to the latest revisions of the following American Welding Society designation:
 - a. AWS D1.1, Structural Welding Code - Steel.
 - b. AWS D1.2, Structural Welding Code - Aluminum.
 - c. AWS D1.6, Structural Welding Code - Stainless Steel.
 - d. 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 DELIVERY STORAGE AND HANDLING

- ##### A. Aluminum to be delivered to the fabricator in accordance with ASTM B 660, complying with the commercial packing and preservation requirements.

B. Epoxy Adhesive

1. Store epoxy cartridges on pallets or shelving in a covered storage area.
2. Control temperature above 60 degrees F and dispose of cartridges if shelf life has expired.

C. Vinyl Ester Products

1. Store components on pallets or shelving in a covered storage area with locking door.
2. Control temperature within 41 to 77 degrees F and dispose of product if shelf life has expired.

1.06 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 Schedule 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. Allowance shall be made for trimming and fitting.

1.07 SCHEDULING

- 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 MATERIALS

- A. Steel, in accordance with the following ASTM Designations unless otherwise indicated:
1. Steel plates and structural shapes ASTM A36.
 2. Steel Pipe A501 or A53, Type E or S, Grade B
 3. Structural Steel Tubing A500, Grade B
 4. Steel Bolts and Nuts:
 - a. Carbon Steel A307 or A36
 - b. High-Strength A325, Type 3
 - c. Galvanized Steel Bolts and Nuts A307 or A36, with A153
Zinc Coating, and ANSI B1.1
 - d. Eyebolts A489
 - e. Threaded Rods A36
 - f. Flat Washers (Unhardened) F844; use A153 for Zinc Coating
 - g. Flat Washers (Hardened) F436
- B. Stainless Steel, Type 316 and in accordance with the following ASTM designations unless otherwise indicated:
1. Bars and Shapes A276, AISI Type 316
 2. Plate, Sheet, and Strip A167, AISI Type 316
 3. Bolts and Threaded Rods F593, AISI Type 316,
 4. Nuts F594, AISI Type 316,
 5. Welding Rods and Bare Electrodes: Compatible with the material to be welded per the AWS D1.6 specifications.
- C. Aluminum, in accordance with the following ASTM designations and alloy and temper designations of The Aluminum Association:
1. Structural shapes B 308, 6061-T6 mill finish.

- 2. Extruded shapes B 221, 6061-T6 mil finish
 - 3. Structural Plates B 209, 6061-T6 mil finish
 - 4. Sheets Alclad 3003-H14 and 3003
 - 5. Bolts and nuts F468, 2024-T4
 - 6. Aluminum Tread Plate:
 - a. In accordance with ASTM B 632, 6061-T6.
 - b. Provide a clear, Class II, anodized finish in accordance with Aluminum Association Designation AA-A31, 0.4 mils thick minimum.
 - 7. Structural Aluminum Tubes ASTM B 429, 6063-T52, mill finish.
 - 8. Welding Rods and Bare Electrodes:
 - a. Compatible with the material to be welded per the AWS D1.2 specifications.
 - b. Aluminum items to be anodized shall not be welded using 4043 weld rod.
- D. Cast Iron
- 1. In accordance with ASTM A48, Class 35.

2.02 GROUT

- A. In accordance with SECTION 03600.

2.03 FASTENERS

- A. Provide Stainless steel fasteners for all connections unless indicated otherwise
- B. Bolts:
 - 1. Stainless steel in accordance with ASTM F 593, Alloy Group 2, Type 316,
 - 2. CW with hexagonal heads shall be provided for connections.
- C. Nuts:
 - 1. Stainless steel in accordance with ASTM F 594, Alloy Group 2, Type 316,
 - 2. CW with hexagonal heads, and thread designation to match stainless steel bolts shall be provided for connections.
- D. Washers:
 - 1. In accordance with ASTM F 436, except that the material shall be Type 316 stainless steel in accordance with ASTM A 276.
- E. Stainless steel fasteners for framing connections
 - 1. Provide 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.
- F. Machine Screws:
 - 1. Stainless steel in accordance with ASME B18.6.3, Type 316.

2.04 PIPE BOLLARDS

- A. Fabricated from Schedule 40, welded, galvanized steel pipe in accordance with ASTM A53
- B. Provide size and quantity indicated on the Drawings.

2.05 ALUMINUM ACCESS HATCH

A. General

1. Provide size and quantity indicated on the Drawings. The door leaf shall be flood tight with 1/4-inch aluminum diamond pattern plate to withstand a live load of 625 pounds per square foot and withstand 10 feet of water head.

B. Construction

1. Channel frame shall be 1/4-inch aluminum with an angled flange around the perimeter to allow for bolting to concrete.
2. Door(s) shall be equipped with 316 stainless steel hinges, stainless steel hinge, compression spring operators for easy operation, and automatic hold-open arm with release handle. A slam lock with removable handle shall be provided. Provide recessed hasp for pad lock on all exterior hatches.
3. Hardware shall be 316 stainless steel.
4. Gasket shall be 3/8" neoprene.
5. Factory finish shall be mill finish with bituminous coating applied to exterior portions of the frame which will be in contact with concrete.

C. Warrantee

1. Manufacturer shall guarantee against defects in materials and/or workmanship for five years.

D. Manufacturer

1. The access hatch shall be Floodtight type A-FPS as manufactured by the Acudor, Roseland, New Jersey, or be an acceptable equivalent product.

2.06 ANCHOR BOLTS

A. To be Stainless Steel.

B. Configuration and specific type as specified, as listed in the associated equipment specifications and as detailed on the Contract Drawings.

C. Provide Antiseizing Lubricant for all stainless steel threads.

D. Anchor Bolt Sleeves

1. High Density Polyethylene Plastic:
 - a. Single unit construction with deformed sidewalls such that the concrete and grout lock in place.
 - b. The top of the sleeve shall be self-threading to provide adjustment of the threaded anchor bolt projection.
 - c. Material requirements:
 - 1) Plastic: High density polyethylene.
 - 2) Density: ASTM D 1505
 - d. Manufacturer:
 - 1) Sinco West, Simi Valley, CA
 - 2) Or equal
2. Fabricated Steel Sleeve
 - a. A 36 steel.

E. Neoprene Gasket

1. ASTM D 1056 RE-41-E, soft, closed-cell, neoprene gasket material, suitable for exposure to sewage and sewage gases, unless otherwise shown.
2. Thickness: Minimum 1/4 inch.
3. Furnish without skin coat.
4. Furnish two spare gaskets for each location shown requiring neoprene gaskets, and furnish one roll of 4-inch wide by 50-foot long neoprene gasket material with 1 pint of manufacturer's recommended adhesive.
5. Manufacturers and Product:
 - a. Rubatex Division of Great American Industries, Bedford, VA; Rubatex No. R-411-N.
 - b. Garlock Manufacturing, San Francisco, CA.
 - c. Or equal.

2.07 CHEMICAL ANCHORING SYSTEMS

A. Epoxy Anchors

1. Anchor Rod: Stainless steel threaded rod free of grease, oil or other deleterious material with a 45-degree chisel point.
2. Epoxy Adhesive:
 - a. ASTM C 881, Type 1, Grade 3, Class A, B, or C.
 - b. Two-component, 100 percent solids, nonsag, paste, insensitive to moisture, designed to be used in adverse freeze/thaw environments and gray in color.
 - c. Cure Temperature, Pot Life, and Workability: Compatible for intended use and environmental conditions.
3. Mixed Epoxy Adhesive: Nonsag paste consistency, with ability to remain in a 1-inch diameter overhead drilled hole without runout, having the following properties:
 - a. Slant Shear Strength, ASTM C 881, No Failure In Bond Line, Dry/Moist Conditions: 5,000 psi.
 - b. Compressive Strength, ASTM D 695; 14,000 psi, minimum.
 - c. Tensile Strength, ASTM D 695: 4,500 psi.
 - d. Heat Deflection Temperature, ASTM D 648 E2: 135 degrees F, minimum.
4. Epoxy Adhesive Packaging:
 - a. Disposable, self-contained cartridge system capable of dispensing both epoxy components in the proper mixing ratio, and fit into a manually or pneumatically operated caulking gun.
 - b. Cartridge Markings: Include manufacturer's name, batch number, mix ratio by volume, product expiration data, ANSI hazard classification, and appropriate ANSI handling precautions.
5. Manufacturer's and Products:
 - a. Adhesives Technology Corp.; Anchor-It Fastening Systems, HS 200 Epoxy Resin.
 - b. ITW Ramse/Red Head; Epcon Ceramic 6 Epoxy Anchor System.
 - c. Covert Operations; CIA Epoxy Anchors with viscosity to suit application.
 - d. Rawplug Co., Inc.; Rawl/Sika Foil Fast Epoxy Injection Gel System.

B. Adhesive Anchors

1. Two-component vinyl ester adhesive, insensitive to moisture, designed to be installed in adverse freeze/thaw environments.

2.08 LOOSE LINTELS

- A. Provide loose lintels as indicated on the Drawings. Fabricated from structural steel shapes and plates. Provide lintels hot-dip galvanized after fabrication.
- B. Provide galvanized steel loose lintels for wall openings up to 5'-0" wide. Provide galvanized steel lintels and anchor to precast concrete inner lintels for wall openings over 5'-0" wide. Space anchors at maximum 4'-0" on centers with minimum of 2 anchors per lintel.

2.09 FABRICATION

A. General

1. Metals shall be sheared and punched cleanly and accurately. Burrs shall be removed.
2. 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.
3. Corners and seams shall be welded continuously to comply with the following:
 - a. Materials and methods shall be used that minimize distortion and develop strength and corrosion resistance of the base metals.
 - b. Fusion shall be obtained without undercut or overlap.
 - c. Welding flux shall be removed immediately.
 - d. 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.
4. 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.
5. Fabrications exposed to view in the completed Work, shall be provided with smooth, flat surfaces without blemishes.
6. Fabrications with exposed pitting, seam marks, roller marks, rolled trade names, or roughness shall not be used.

B. Shop Assembly:

1. Items shall be preassembled in shop to greatest extent possible to minimize field splicing and assembly.
2. Units shall be disassembled only as necessary for shipping and handling limitations.
3. 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.
4. Units shall be clearly marked for reassembly and coordinated installation.

2.10 FINISHES

- A. Fabrications shall be finished after shop assembly.
- B. Anodized aluminum finishes to be in accordance with the Aluminum Association's standards for Anodized Architectural Aluminum as published by the American Architectural Manufacturer's Association (AAMA).
- 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.
- D. Galvanizing

1. Items of miscellaneous ironwork and steel work indicated on the Drawings or specified to be galvanized shall be zinc-coated by the hot-dip process in accordance with ASTM Standard Specification for Zinc (Hot-Galvanized) Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars, and Strip, Designation A123; or ASTM Standard Specifications for Zinc Coating (Hot-Dip) on Iron and Steel Hardware, Designation A153, as appropriate.
- E. Aluminum Surfaces in Contact with Concrete
1. Paint-on coating suitable for embedment in, or surface mounting to, concrete to prevent adverse reaction between aluminum and concrete surfaces.
 2. Apply one coat of the following:
 - a. Coal Tar 46-465 H. B. Tnemecol, Tnemec Company, North Kansas City, MO.
 - b. Bitumastic Super Service Black, KOP-COAT, Inc., Pittsburgh, PA.
 - c. Tarmastic 100 Porter Coatings Division, Porter Paint Co., Louisville, KY.
 - d. Or equal.

PART 3 EXECUTION

3.01 INSTALLATION

A. Field Assembly:

1. Metal fabrications shall be cut, reinforced, drilled, and tapped cleanly and accurately to receive finish hardware, screws, and similar items.
2. Exposed work shall be formed true to line and level, with accurate angles and surfaces, and straight rounded edges.
3. Sharp or rough areas shall be removed on exposed traffic surfaces.
4. Exposed connections shall be formed with hairline joints, flush and smooth, using concealed fasteners where possible.
5. 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.

B. Erection Tolerances

1. Maximum Variation from Plumb: 1/4 inch per story, noncumulative.
2. Maximum Offset from True Alignment: 1/4 inch.

C. Anchorage:

1. Coordinated type of anchorage with supporting structure.
2. Anchoring devices shall be fabricated and spaced to secure metal fabrications in place and to support indicated loads.

D. Fastening to In-Place Construction:

1. Anchorage devices and fasteners shall be provided where necessary for securing metal fabrications to in-place construction.

E. Cutting, Fitting, and Placement:

1. Cutting, drilling, and fitting for the installation of metal fabrications shall be performed as required.
2. 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.

- F. Temporary bracing or anchors shall be provided in formwork for items that are to be built into concrete.
- G. 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.
- H. 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.

3.02 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 in accordance with SECTION 03600.
 - 2. Grout shall be solidly packed between bearing surfaces and plates to ensure that no voids remain.

3.03 ANCHOR BOLTS (CAST IN PLACE)

- A. Accurately locate and hold anchor bolts in place with templates at the time concrete is placed.
- B. Use sleeves for location adjustment and provide two nuts and one washer per bolt of same material as bolt. Minimum bolt size: 1/2-inch diameter by 12 inches long, unless otherwise shown.
- C. All anchors and anchor bolts shall be properly located and shall be built into the connecting work when the work is built. Expansion bolts shall be inserted into drilled holes.

3.04 ANCHORING SYSTEMS (CURED CONCRETE)

- A. Begin installation only after concrete or masonry receiving anchors have attained design strength.
- B. Do not install an anchor closer than six times its diameter to either an edge of concrete or masonry, or to another anchor, unless specifically shown otherwise.
- C. Install in accordance with manufacturer's specific quality control submittal instructions. Hole diameters are critical to installation, use only drills recommended by anchor manufacturer. Follow manufacturer's safe handling instructions.

- D. Epoxy or Adhesive Anchors: Do not install when temperature of concrete is below 40 degrees F or above 100 degrees F, unless stated otherwise in manufacturer's written instructions.
- E. Follow specific manufacturer safe handling practices when handling and installing concrete anchors.

3.05 FASTENER SCHEDULE:

<u>Service Use and Location</u>	<u>Product</u>	<u>Remarks</u>
Anchor Bolts Cast Into Concrete for Equipment Bases:		
Dry Areas	Stainless steel bolts, unless otherwise specified with equipment	
Submerged or Wet Areas	Stainless steel bolts with fusion bond coating unless otherwise specified with equipment	See Section 09900, Painting and Protection Coating
Anchor Bolts Cast Into Concrete for Metal Fabrications and Structural Components.		
Dry or Protected Areas Exterior, Wet, Washdown, and Chemical Handling Areas	Stainless steel bolts with fusion bond coating	See Section 09900, Painting
Anchors for Metal Components to Concrete: e.g. Electrical Panels and Equipment:		
Dry Areas	Stainless steel wedge or expansion anchors	
Wet and Damp Areas	Epoxy or adhesive stainless steel anchors	
Submerged or Buried in Earth	Epoxy or adhesive stainless steel anchors	
Connections for Structural Steel Components:		
Exterior and Interior	High-strength zinc-coated steel bolts	See Section 05120, Structural Steel
Connections for Steel Fabrications:		
Exterior and Interior	Zinc-coated steel bolts	See Section 05120, Structural Steel
Connections for Aluminum Components:		
Exterior and Interior	Stainless steel bolts	
All Others:		
Exterior and Interior	Stainless steel fasteners	

- A. Do not use epoxy anchors to support fire-resistive construction or where ambient temperature will exceed 120 degrees F.

3.06 ACCESS COVERS AND HATCHES

- A. Accurately position prior to placing concrete, such that covers and hatches are flush with floor surface.
- B. Protect from damage resulting from concrete placement. Thoroughly clean exposed surfaces of concrete spillage to obtain a clean, uniform appearance.

3.07 PIPE BOLLARDS

- A. 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 pipe 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.

3.08 ALUMINUM WORK PROTECTION

- A. Areas where the coating has been damaged by abrasion or other cause shall be cleaned and repainted as directed so that the aluminum will have a complete protective 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.

3.09 CLEANING AND TOUCHUP

- A. Painted Surfaces: Clean and touchup paint field welds, bolted connections, and abraded areas of shop paint as specified in SECTION 09900 or as approved by the Engineer.
- 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.
- C. After aluminum has been erected, it shall be cleaned with mild soap and water, followed by a clear water rinse.

END OF SECTION

SECTION 05521

PIPE AND TUBE RAILINGS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section Includes:

- 1. Steel pipe guards, exterior rooftop.
- 2. Steel pipe guardrails, exterior.

- B. Related Sections:

- 1. Division 3 Section "Cast-in-Place Concrete."
- 2. Division 5 Section "Structural Steel Framing."
- 3. Division 7 Section "Thermoplastic Polyolefin (TPO) Roofing."

1.03 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design railings, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

- B. Structural Performance: Railings shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

- 1. Handrails and Top Rails of Guards:

- a. Uniform load of 50 lbf/ ft. applied in any direction.
- b. Concentrated load of 200 lbf applied in any direction.
- c. Uniform and concentrated loads need not be assumed to act concurrently.

- 2. Infill of Guards:

- a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft.
- b. Infill load and other loads need not be assumed to act concurrently.

- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.
 - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.
- D. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1.04 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Grout, anchoring cement, and paint products.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
- C. Samples for Initial Selection: For products involving selection of color, texture, or design.
- D. Samples for Verification: For each type of exposed finish required.
 - 1. Submit two 3 inch by 6 inch samples of factory-applied coatings and colors proposed for use for approval prior to coating application
- E. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.05 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified professional engineer, licensed in the Commonwealth of Massachusetts.
- B. Welding certificates.
- C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, according to ASTM E 894 and ASTM E 935.
- D. Certificate of Compliance for Items Coated by Galvanizer: Submit notarized Certificate of Compliance signed by the galvanizer, indicating compliance with requirements of specifications. Include scope of services provided, and quantity and itemized description of items processed.

- E. Certificate of Compliance for Shop Drawing Review by Galvanizer: Submit galvanizer's certification that shop drawings for metal fabrications to receive metal coatings have been reviewed and that fabrications are acceptable to galvanizer for proper application of galvanizing and metal coatings. All drawings should be signed by the galvanizer to indicate acceptance of design for galvanizing.
- F. Certificate of Compliance of Item Identification by Galvanizer: The galvanizer shall mark all lots of material with a clearly visible tag indicating the name of the galvanizer, the type and weight of the coating, and the applicable ASTM Specification Numbers.
 - 1. Submit certification of compliance that items have been tagged.
 - 2. Galvanizer/applicator shall supply a certificate of compliance that all coatings have been performed in accordance with SSPC Qualification Procedure Standard QP 3.
- G. Warranty: Special warranty included in this Section.

1.06 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of railing from single source from single manufacturer.
- B. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- C. Galvanizer: Engage the services of a qualified galvanizer who has demonstrated a minimum of ten years' experience in the successful application of galvanized coatings specified in this specification in the facility where the work is to be performed and who will apply the coatings within the same facility.
 - 1. Galvanizing shall be performed by a company with a minimum of ten years' experience in the successful application of hot-dip galvanizing utilizing the dry kettle process.
- D. Preconstruction Conference for Metal Fabrications to Receive Factory-Applied Metal Coatings: Schedule a meeting to be attended by Contractor, Architect, fabricator, and galvanizer. Agenda to include the following:
 - 1. Project schedule, scope of services, coordination between fabricator and galvanizer, finish of surfaces, application of coatings, submittals, and approvals.

1.07 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

1.08 COORDINATION AND SCHEDULING

- A. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- B. Coordination between Fabricator and Galvanizer: Prior to fabrication and final submittal of shop drawings, direct fabricators to submit shop drawings to the galvanizer for all metal fabrications to receive factory-applied metal coatings. Direct galvanizer to review fabricator's shop drawings for suitability of materials for galvanizing and coatings and coordinate any required modifications to fabrications required to be performed by the fabricator.

1.09 WARRANTY

- A. Special Warranty: Manufacturer's standard form for galvanizing and factory finishing of exterior railings, in which manufacturer warrants the galvanizing and color coat processes to be free from 10% or more visible rust within the specified warranty period.
 - 1. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.
- B. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.

2.02 STEEL AND IRON

- A. Pipe: ASTM A 53/A 53M, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.
 - 1. Provide galvanized and painted finish for exterior installations.

- B. Plates, Shapes, and Bars: ASTM A 36/A 36M.

2.03 FASTENERS

- A. General: Provide the following:

- 1. Hot-Dip Galvanized Railings: Type 304 stainless-steel or hot-dip zinc-coated steel fasteners complying with ASTM A 153/A 153M or ASTM F 2329 for zinc coating.

- B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.

- C. Post-Installed Anchors: Torque-controlled expansion anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.

- 1. Material for Exterior Locations: Alloy Group 1 (A1) stainless-steel bolts, ASTM F 593, and nuts, ASTM F 594.

2.04 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

- B. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

- C. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for exterior applications.

2.05 FABRICATION

- A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.

- B. Assemble railings in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.

- C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- D. Form work true to line and level with accurate angles and surfaces.
- E. Fabricate connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.
- G. Connections: Fabricate railings with welded connections unless otherwise indicated.
- H. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove flux immediately.
 - 4. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.
- I. Form changes in direction as follows:
 - 1. By bending.
- J. Bend members in jigs to produce uniform curvature for each configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.
- K. Close exposed ends of railing members with prefabricated end fittings.
- L. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.
- M. For railing posts set in concrete, provide steel sleeves not less than 6 inches long with inside dimensions not less than 1/2 inch greater than outside dimensions of post, with metal plate forming bottom closure.

2.06 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- D. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.

2.07 STEEL AND IRON FINISHES

A. Galvanized Railings for Exterior Applications:

1. Hot-dip galvanize exterior steel railings, including hardware, after fabrication. Where size of assembly is too large for complete unit galvanizing, galvanize prior to fabrication in as large sections as possible with Architect's written approval.
 - a. Comply with ASTM A 123/A 123M for hot-dip galvanized railings.
 - b. Comply with ASTM A 153/A 153M for hot-dip galvanized hardware.
 - c. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
 - d. Fill vent and drain holes that will be exposed in the finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.
2. Prior to galvanizing, immerse steel in a pre flux solution of zinc ammonium chloride containing high grade zinc and earthly materials. Galvanize all ferrous fasteners, clips, sleeves, anchors and accessories in contact with galvanized railings.
 - a. Product: Subject to compliance with requirements, provide the following, or equal:
 - 1) **Duncan Galvanizing; Duragalv.**
3. Inspect all galvanized materials for compliance with requirements and mark with stamp indicating the name of the galvanizer, ASTM specification, and weight of the zinc coating in oz./sq.ft.
 - a. Rugosity: Not greater than 4 rug (16-20 microns of variation) when measured by a profilometer over a 1-inch straight line.

- b. Create a 1-3 mil profile on the surface to provide adhesion of thermoset coating.
4. Where galvanizing cannot be completed prior to fabrication, weld joints after fabrication, grind smooth and finish with applied galvanizing recommended by manufacturer.
 5. Shop Coating of Galvanized Steel: Factory-applied metal coatings on galvanized materials.
 - a. Product: Subject to compliance with requirements, provide the following, or equal:
 - 1) **Duncan Galvanizing; Colorgalv Thermoset.**
 - b. Primer shall meet or exceed the following performance criteria:
 - 1) Abrasion Resistance per ASTM D 4060 (CS17 Wheel, 1,000 grams load), 1kg Load: 200 mg loss.
 - 2) Adhesion per ASTM D4541: 1050 psi.
 - 3) Corrosion Weathering per ASTM D5894, 13 Cycles, 4,368 Hours: Rating 10 per ASTM D714 for blistering; Rating 7 per ASTM D610 for rusting.
 - 4) Direct Impact Resistance per ASTM D2794: 160 in. lbs.
 - 5) Flexibility per ASTM D522, 180° Bend, 1 in. Mandrel: Passes.
 - 6) Pencil Hardness per ASTM D3363: 3B.
 - 7) Moisture Condensation Resistance per ASTM D4585, 100° F, 2000 Hours: Passes, no cracking or delamination.
 - 8) Dry Heat Resistance per ASTM D2485: 250° F.
 - c. Topcoat shall meet or exceed the following performance criteria:
 - 1) Abrasion Resistance per ASTM D 4060, CS17 Wheel, 1,000 Cycles 1kg Load: 87.1 mg loss.
 - 2) Adhesion per ASTM D 4541: 1050 psi.
 - 3) Direct Impact Resistance per ASTM D2794: >28 in. pounds.
 - 4) Indirect Impact Resistance per ASTM D2794: 12-14 in. pounds.
 - 5) Dry Heat Resistance per ASTM D2485: 200° F.
 - 6) Salt Fog Resistance per ASTM B 117 9,000 Hours: Rating 10 per ASTM D714 for blistering.
 - 7) Flexibility per ASTM D522, 180° Bend, 1/8 in. Mandrel: Passes.
 - 8) Pencil Hardness per ASTM D3363: 2H.
 - 9) Moisture Condensation Resistance per ASTM D4585, 100° F, 1000 Hours: No blistering or delamination Xenon Arc Test per ASTM D 4798: Pass 300 hours
 - d. Color: As selected by Architect from manufacturer's standard colors.

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL

- A. Fit exposed connections together to form tight, hairline joints.
- B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.
 - 1. Do not weld, cut, or abrade surfaces of railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
 - 2. Set posts plumb within a tolerance of 1/16 inch in 3 feet.
 - 3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet.
- C. Adjust railings before anchoring to ensure matching alignment at abutting joints.
- D. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.02 RAILING CONNECTIONS

- A. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article whether welding is performed in the shop or in the field.
- B. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve extending 2 inches beyond joint on either side, fasten internal sleeve securely to one side, and locate joint within 6 inches of post.

3.03 ANCHORING POSTS

- A. Use metal sleeves preset and anchored into concrete for installing posts. After posts have been inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions.

- B. Form or core-drill holes not less than 5 inches deep and 3/4 inch larger than OD of post for installing posts in concrete. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions.
- C. Leave anchorage joint exposed with 1/8-inch buildup, sloped away from post.

3.04 APPLICATION OF FACTORY-APPLIED METAL COATINGS

- A. Galvanizing Application: Galvanize materials in accordance with specified standards and this specification. Galvanizing shall provide an acceptable substrate for applied coatings. The dry kettle process shall be used to eliminate any flux inclusions on the surface of the galvanized material.
- B. Prior to galvanizing, the steel shall be immersed in a pre-flux solution (zinc ammonium chloride). The pre flux tank must be 12 to 14 Baumé and contain less than 0.4 percent iron. The wet kettle process shall be prohibited.
- C. To provide the galvanized surface required, the following procedures shall be implemented:
 - 1. A monitoring recorder shall be utilized and inspected regularly to observe any variances in the galvanizing bath temperature.
 - 2. The pickling tanks shall contain hydrochloric acid with an iron content less than 8 percent and zinc content less than 3 percent. Titrations shall be taken weekly at a minimum.
 - 3. All chemicals and zinc shall be tested at least once a week to determine compliance with ASTM standards. All testing shall be done using atomic absorption spectrometry or x-ray fluorescence (XRF) equipment at a lab in the galvanizing plant.
- D. Finish coatings shall be applied under the following conditions.
 - 1. Minimum air temperature shall be 65 degrees F. Surface temperature of steel shall be 60 degrees to 95 degrees F and, in any event, be 5 degrees F higher than the dew point. Humidity shall be 85 percent maximum.
 - 2. The use of iron or steel shot and sand and aluminum oxide grit as a blast medium, and power wire brushes are not permitted.
 - 3. Surface of substrate shall be dry and free from dust, dirt, oil, grease or other contaminants. Coating and cure facility shall be maintained free of airborne dust and dirt until coatings are completely cured.

3.05 ADJUSTING AND CLEANING

- A. Touch-Up and Repair: For damaged and field-welded metal coated surfaces, clean welds, bolted connections and abraded areas.
 - 1. For galvanized surfaces, apply organic zinc repair paint complying with requirements of ASTM A 780, modified to 95 percent zinc in dry film. Galvanizing repair paint shall have 95 percent zinc by weight. Thickness of applied galvanizing repair paint shall be not less than coating thickness required by ASTM A 123 or A 153 as applicable. Touch-up of galvanized surfaces with silver paint, brite paint, or aluminum paints is not acceptable.
 - 2. For factory-applied finish coatings, field-touch-up to be performed by factory approved personnel for warranties to apply. Touch-up shall be such that repair is not visible from a distance of 6 feet. If non factory-approved technicians are used for field touch-up, no warranties shall exist.
 - 3. A touch-up repair kit or touchup instructions shall be provided to the Owner for each type of factory-applied finish.

3.06 PROTECTION

- A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

DIVISION 06

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 06105

MISCELLANEOUS ROUGH CARPENTRY

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section includes:

- 1. Wood blocking, nailers, and plywood associated with low slope membrane roofing.
- 2. Wood blocking at window openings.
- 3. Plywood backing panels.
- 4. Door hardware installation.

- B. Related Sections include the following:

- 1. Division 5 Section "Cold Formed Metal Framing" for exterior metal stud framing.
- 2. Division 7 Section "Thermoplastic Polyolefin (TPO) Roofing" for furnishing and installation of wood blocking, nailers and plywood associated with low slope membrane roofing.

1.03 DEFINITIONS

- A. Dimension Lumber: Lumber of 2 inches nominal or greater but less than 5 inches nominal in least dimension.

- B. Lumber grading agencies, and the abbreviations used to reference them, include the following:

- 1. NeLMA: Northeastern Lumber Manufacturers' Association.
- 2. NLGA: National Lumber Grades Authority.

1.04 SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
 - 1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
 - 2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
 - 3. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
 - 4. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

- B. Research/Evaluation Reports: For the following, showing compliance with building code in effect for Project:
 - 1. Preservative-treated wood.
 - 2. Fire-retardant-treated wood.
 - 3. Power-driven fasteners.
 - 4. Powder-actuated fasteners.
 - 5. Expansion anchors.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Stack lumber flat with spacers between each bundle to provide air circulation. Provide for air circulation around stacks and under coverings.

- B. Deliver interior wood materials that are to be exposed to view only after building is enclosed and weatherproof, wet work other than painting is dry, and HVAC system is operating and maintaining temperature and humidity at occupancy levels.

PART 2 - PRODUCTS

2.01 WOOD PRODUCTS, GENERAL

- A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
 - 1. Factory mark each piece of lumber with grade stamp of grading agency.
 - 2. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
 - 3. Provide dressed lumber, S4S, unless otherwise indicated.
- B. Plywood: DOC PS 1.
 - 1. Thickness: As needed to comply with requirements specified, but not less than thickness indicated.
 - 2. Factory mark panels to indicate compliance with applicable standard.

2.02 WOOD-PRESERVATIVE-TREATED MATERIALS

- A. Manufacturers: Subject to compliance with requirements, provide products by one the following:
 - 1. Georgia Pacific.
 - 2. Hoover Treated Wood Products, Inc.
 - 3. Koppers Performance Chemicals.
- B. Preservative Treatment by Pressure Process: AWWPA U1; Use Category UC2 for interior construction not in contact with ground, Use Category UC3b for exterior construction not in contact with ground, and Use Category UC4a for items in contact with ground.
 - 1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic, chromium or chromated copper arsenate (CCA).
- C. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or does not comply with requirements for untreated material.
- D. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.

- E. Application: Treat miscellaneous carpentry, including the following:
 - 1. Wood sills, sleepers, blocking, furring, and similar concealed members in contact with masonry or concrete.

2.03 FIRE-RETARDANT-TREATED MATERIALS

- A. General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Dricon.
 - 2. Hoover Treated Wood Products, Inc.
 - 3. Koppers Performance Chemicals.
- C. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet beyond the centerline of the burners at any time during the test.
 - 1. Use treatment that does not promote corrosion of metal fasteners.
 - 2. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated lumber and plywood by pressure process after being subjected to accelerated weathering according to ASTM D 2898. Use for exterior locations and where indicated.
 - 3. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D 3201 at 92 percent relative humidity. Use where exterior type is not indicated.
- D. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Kiln-dry plywood after treatment to a maximum moisture content of 15 percent.
- E. Identify fire-retardant-treated wood with appropriate classification marking of testing and inspecting agency acceptable to authorities having jurisdiction.
- F. Application: Treat the following:
 - 1. Concealed blocking at window opening framing.
 - 2. Plywood backing panels.

2.04 MISCELLANEOUS LUMBER

- A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
 - 1. Blocking.
 - 2. Nailers.
 - 3. Furring.
- B. For items of dimension lumber size, provide Construction or No. 2 lumber with 15 percent maximum moisture content and the following species:
 - 1. Hem-fir (north); NLGA.
- C. For blocking not used for attachment of other construction Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.
- D. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.
- E. For furring strips for installing plywood, select boards with no knots capable of producing bent-over nails and damage to paneling.
- F. Application: Provide kiln dried lumber in the following locations:
 - 1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing.

2.05 PLYWOOD BACKING PANELS

- A. Telephone and Electrical Equipment Backing Panels: DOC PS 1, Exposure 1, C-D Plugged, fire-retardant treated, in thickness indicated or, if not indicated, not less than 1/2-inch nominal thickness.

2.06 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacture.
 - 1. Where carpentry is exposed to weather, in ground contact, preservative- and fire retardant treated, or in area of high relative humidity, provide fasteners of with hot-dip zinc coating complying with ASTM A 153/A 153M.
- B. Nails, Brads, and Staples: ASTM F 1667.

- C. Power-Driven Fasteners: NES NER-272.
- D. Wood Screws: ASME B18.6.1.
- E. Lag Bolts: ASME B18.2.1.
- F. Bolts: Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers.
- G. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry assemblies and equal to 4 times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.
 - 1. Material: Stainless steel with bolts and nuts complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2.

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL

- A. Set carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit carpentry to other construction; scribe and cope as needed for accurate fit. Locate nailers, blocking, and similar supports to comply with requirements for attaching other construction.
- B. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.
- C. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.
- D. Sort and select lumber so that natural characteristics will not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
- E. Securely attach carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
 - 1. NES NER-272 for power-driven fasteners.
 - 2. Table 2305.2, "Fastening Schedule," in the Massachusetts State Building Code.

- F. Use common wire nails, unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood; do not countersink nail heads, unless otherwise indicated.

3.02 WOOD BLOCKING AND NAILER INSTALLATION

- A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.
- B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces, unless otherwise indicated.

3.03 WOOD FURRING INSTALLATION

- A. Install level and plumb with closure strips at edges and openings. Shim with wood as required for tolerance of finish work.
- B. Furring to Receive Plywood: Install 1-by-3-inch nominal- size furring vertically 24 inches o.c.

3.04 FIRE-RETARDANT-TREATED (FRT) MATERIALS INSTALLATION

- A. Cutting to length, drilling holes, joining cuts and light sanding are permissible. It is not necessary to field treat cut ends to maintain flame spread rating.
 - 1. Ripping, milling, and surfacing of FRT lumber is not permitted.
 - 2. FRT plywood can be cut in either direction without loss of fire protection.

3.05 FINISH HARDWARE INSTALLATION

- A. General: Comply with requirements indicated below and in Division 8 Section "Door Hardware."
- B. Mounting Heights: Mount door hardware units at heights indicated as follows unless otherwise indicated or required to comply with governing regulations.
 - 1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."

- C. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 9 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.
 - 1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
 - 2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
- D. Thresholds: Set thresholds for exterior doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."

3.06 PROTECTION

- A. Protect rough carpentry from weather. If, despite protection, rough carpentry becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION

SECTION 06160

SHEATHING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes the following:
 - 1. Exterior gypsum sheathing.
- B. Related Sections include the following:
 - 1. Division 5 Section "Cold Formed Metal Framing" for exterior non-loadbearing metal stud framing.
 - 2. Division 6 Section "Miscellaneous Rough Carpentry" for wood blocking.
 - 3. Division 7 Section "Thermal Insulation" for thermal insulation.
 - 4. Division 7 Section "Fluid-Applied Membrane Air Barriers."

1.03 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.04 SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
- B. Evaluation Reports: For following products, from ICC-ES:
 - 1. Exterior gypsum sheathing.
- C. Special Warranty: Sample of special warranties included in this Section.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Stack panels flat with spacers between each bundle to provide air circulation. Provide for air circulation around stacks and under coverings.

1.06 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace exterior gypsum sheathing that fails in materials or workmanship within specified warranty period.

- 1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 GLASS-MAT GYPSUM WALL SHEATHING

- A. Glass-Mat Gypsum Wall Sheathing: ASTM C 1177.

- 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. CertainTeed; GlasRoc Sheathing.
 - b. G-P Gypsum Corporation; Dens-Glass Fireguard Sheathing.
 - c. National Gypsum; Gold Bond Brand e²XP Sheathing.
 - d. USG Corporation; Securock Glass-Mat Sheathing Panels.
- 2. Type and Thickness: Type X, 5/8-inch thick.

2.02 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacture.
- B. Nails, Brads, and Staples: ASTM F 1667.
- C. Power-Driven Fasteners: NES NER-272.
- D. Screws for Fastening Gypsum Sheathing to Cold-Formed Metal Framing: Steel drill screws, in length recommended by sheathing manufacturer for thickness of sheathing board to be attached, with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B 117.
 - 1. For steel framing less than 0.0329 inch thick, attach sheathing to comply with ASTM C 1002.

2. For steel framing from 0.033 to 0.112 inch thick, attach sheathing to comply with ASTM C 954.

2.03 SHEATHING JOINT-AND-PENETRATION TREATMENT MATERIALS

- A. Exterior sheathing joint and penetration treatment materials furnished and installed by Division 7 Section "Fluid Applied Membrane Air Barriers."

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL

- A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
- B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction, unless otherwise indicated.
- C. Securely attach to substrate by fastening as indicated, complying with the following:
 1. NES NER-272 for power-driven fasteners.
 2. Table 2304.9.1, "Fastening Schedule," in ICC's "International Building Code."
- D. Coordinate wall sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.
- E. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.
- F. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

3.02 GYPSUM SHEATHING INSTALLATION, GENERAL

- A. Apply panels perpendicular to supports, with end joints staggered and located over supports.
 1. Install with 1/4-inch open space where panels abut other construction or structural penetrations.
 2. Fasten with corrosion-resistant screws.
- B. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

- C. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction, unless otherwise indicated.
- D. Securely attach to substrate by fastening as indicated, complying with the following:
 - 1. NES NER-272 for power-driven fasteners.
 - 2. Table 2304.9.1, "Fastening Schedule," in the New Hampshire State Building Code.
- E. Coordinate wall sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.
- F. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.
- G. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

3.03 GYPSUM SHEATHING INSTALLATION

- A. Comply with GA-253 and with manufacturer's written instructions.
 - 1. Fasten gypsum sheathing to cold-formed metal framing with screws.
 - 2. Install boards with a 3/8-inch gap where non-load-bearing construction abuts structural elements.
 - 3. Install boards with a 1/4-inch gap where they abut masonry or similar materials that might retain moisture, to prevent wicking.
- B. Apply fasteners so heads bear tightly against face of sheathing boards but do not cut into facing.
- C. Horizontal Installation: Install sheathing with V-grooved edge down and tongue edge up. Interlock tongue with groove to bring long edges in contact with edges of adjacent boards without forcing. Abut ends of boards over centers of studs, and stagger end joints of adjacent boards not less than one stud spacing. Attach boards at perimeter and within field of board to each steel stud.
 - 1. Space fasteners approximately 8 inches o.c. and set back a minimum of 3/8 inch from edges and ends of boards.
- D. Vertical Installation: Install board vertical edges centered over studs. Abut ends and edges of each board with those of adjacent boards. Attach boards at perimeter and within field of board to each stud.

1. Space fasteners approximately 8 inches o.c. and set back a minimum of 3/8 inch from edges and ends of boards.

END OF SECTION

DIVISION 07

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 07210
THERMAL INSULATION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes the following:
 - 1. Perimeter wall insulation (rainscreen).
 - 2. Thermal insulation at roof perimeter.
 - 3. Fire safing insulation.
- B. Related Sections include the following:
 - 1. Division 5 Section "Cold Formed Metal Framing" for metal stud framing.
 - 2. Division 7 Section "Composite Framing Support System."
 - 3. Division 7 Section "Foamed-In-Place Insulation" for closed cell insulation.
 - 4. Division 7 Section "Thermoplastic Polyolefin (TPO) Roofing" for insulation specified as part of roofing construction.

1.03 REFERENCES

- A. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components.

1.04 DEFINITIONS

- A. Mineral-Fiber Insulation: Insulation composed of rock-wool fibers, slag-wool fibers, or glass fibers; produced in boards and blanket with latter formed into batts (flat-cut lengths) or rolls.

1.05 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

- B. Samples for Verification: Full-size units for each type of exposed insulation indicated.
- C. Low-emitting product certification.

1.06 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each product, for tests performed by a qualified testing agency.

1.07 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of building insulation through one source from a single manufacturer.
- B. Installer Qualifications: The installation work of this Section shall be performed by an experienced contractor with a minimum of 2 years' experience installing similar assemblies.
- C. Fire-Test-Response Characteristics: Provide insulation and related materials with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.
 - 1. Surface-Burning Characteristics: ASTM E 84.
 - 2. Fire-Resistance Ratings: ASTM E 119.
 - 3. Combustion Characteristics: ASTM E 136.
- D. Preinstallation Meeting: Agenda shall include, at a minimum, materials proposed for use, sequence of construction, coordination with substrate preparation, compatibility of materials, coordination with installation of adjacent and covering materials. Attendance is required by representatives of related trades including covering materials, substrate materials and adjacent materials.
- E. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Protect insulation materials from physical damage and from deterioration by moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

PART 2 - PRODUCTS

2.01 MINERAL-WOOL BOARD INSULATION (RAINSCREEN)

- A. Manufacturers: Subject to compliance with requirements, provide one of the following:
1. Johns Manville; MinWool Curtainwall.
 2. Rockwool; CAVITYROCK.
 3. Thermafiber; RainBarrier HD.
- B. Mineral-Wool Board Insulation: ASTM C 612; water repellent rigid insulation board with a rigid upper surface, with maximum flame-spread and smoke-developed indexes of zero, per ASTM E 84; passing ASTM E 136 for combustion characteristics.
1. Thicknesses: As indicated on Drawings.
 2. R-Value: 4.2 per inch, minimum.
 3. Nominal density: Manufacturer's standard, not less than 6.0 lbs./cu. ft.
 4. Water vapor permeance: 27.2 Perm minimum.
 5. Moisture sorption: 1 % maximum to ASTM C1104/C1104M.
 6. Fungi resistance: Zero mold growth to ASTM C1338.

2.02 MINERAL-WOOL BLANKET INSULATION (THERMAL)

- A. Manufacturers: Subject to compliance with requirements, provide one of the following:
1. Johns Manville; MinWool Sound Attenuation Fire Batts (SAFB).
 2. Rockwool; COMFORTBATT.
 3. Thermafiber; SAFB.
- B. Unfaced, Mineral-Wool Blanket Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers; with maximum flame-spread and smoke-developed indexes of 0, per ASTM E 84; passing ASTM E 136 for combustion characteristics.
1. Thickness: As indicated on Drawings.
 2. R-Value: Minimum 3.5 per inch.
 3. Nominal density of 2.0 lbs/cu. ft minimum.

2.03 MINERAL-WOOL-BOARD INSULATION (FIRE SAFING)

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Johns Manville; MinWool Safing.
 - 2. Rockwool; SAFE.
 - 3. Thermafiber; Safing Insulation.

- B. Unfaced, Mineral-Wool Board Insulation: ASTM C 612; water repellent rigid insulation board with a rigid upper surface, with maximum flame-spread and smoke-developed indexes of zero, per ASTM E 84; passing ASTM E 136 for combustion characteristics.
 - 1. Nominal density of 4.5 lb/cu. ft. minimum.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements of Sections in which substrates and related work are specified and for other conditions affecting performance.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected. Commencement of work indicates acceptance of substrates.

3.02 PREPARATION

- A. Clean substrates of substances harmful to insulation or vapor retarders, including removing projections capable of puncturing vapor retarders or of interfering with insulation attachment.

3.03 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and application indicated.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed at any time to ice, rain, and snow.
- C. Extend insulation in thickness indicated to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

- D. For preformed insulating units, provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.

3.04 INSTALLATION OF GENERAL BUILDING INSULATION

- A. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.
- B. Install mineral-fiber insulation in cavities formed by framing members according to the following requirements:
 - 1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill cavity, provide lengths that will produce a snug fit between ends.
 - 2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
- C. Install unfaced, slag-wool-fiber/rock-wool-fiber blanket insulation in penetrations in all non-fire rated horizontal floor/ceiling assemblies, including edge of slab conditions indicated. Fill annular space of penetration to resist the free passage of flame and the products of combustion.

3.05 PROTECTION

- A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION

SECTION 07211

FOAMED-IN-PLACE INSULATION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section Includes:
 - 1. Closed-cell spray polyurethane foam.
- B. Related Sections include the following:
 - 1. Division 7 Section "Thermal Insulation."

1.03 REFERENCES

- A. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components.

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Low-emitting product certification.

1.05 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Test Reports: For each product, for tests performed by a qualified testing agency.
- C. Evaluation Reports: For spray-applied polyurethane foam-plastic insulation, from ICC-ES.

1.06 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.
- B. Fire-Test-Response Characteristics: Provide insulation and related materials with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.
 - 1. Surface-Burning Characteristics: ASTM E 84.
 - 2. Fire-Resistance Ratings: ASTM E 119.
 - 3. Combustion Characteristics: ASTM E 136.

PART 2 - PRODUCTS

2.01 CLOSED-CELL SPRAY POLYURETHANE FOAM

- A. Closed-Cell Spray Polyurethane Foam: ASTM C 1029, Type II, minimum density of 2.0 lb/cu. ft. and minimum aged R-value at 1-inch thickness of 6.6 deg F x h x sq. ft./Btu at 75 deg F.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. BASF Polyurethane Foam Enterprises LLC; Walltite.
 - b. Icynene; MD-C-200.
 - c. Johns Manville; Corbond III.
 - 2. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - a. Flame-Spread Index: 25 or less.
 - b. Smoke-Developed Index: 450 or less.
 - 3. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.
 - a. Product must be approved for use in Type II construction in accordance with the Massachusetts State Building Code (IBC) Section 2603.5 and tested in accordance with and comply with the acceptance criteria of NFPA 285.
 - 4. Thickness: As indicated.

5. Material Properties:
 - a. R-Value: 6.6 per inch, minimum.
 - b. Vapor Permeance: ASTM E 96, 0.90 at 2.5 inch thickness.
 - c. Density: ASTM D 1622, minimum 2.0 lbs./cu.ft.
 - d. Air Permeance: Maximum 0.004 cfm/sq. ft. of surface area at 1.57-lbf/sq. ft. pressure difference (0.02 L/s*m² at 75 Pa); ASTM E 2178.
6. Free of Urea-Formaldehyde: Insulation manufactured with no urea-formaldehyde.

2.02 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by insulation manufacturer where required for adhesion of insulation to substrates.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Verify that substrates are clean, dry, and free of substances that are harmful to insulation.
- B. Priming: Prime substrates where recommended by insulation manufacturer. Apply primer to comply with insulation manufacturer's written instructions. Confine primers to areas to be insulated; do not allow spillage or migration onto adjoining surfaces.

3.02 INSTALLATION

- A. Comply with insulation manufacturer's written instructions applicable to products and applications.
- B. Spray insulation to envelop entire area to be insulated and fill voids.
- C. Apply in multiple passes to not exceed maximum thicknesses recommended by manufacturer. Do not spray into rising foam.
- D. Framed Construction: Install into cavities formed by framing members to achieve thickness indicated on Drawings.
- E. Miscellaneous Voids: Apply according to manufacturer's written instructions.

3.03 PROTECTION

- A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes.

END OF SECTION

SECTION 07272
FLUID-APPLIED MEMBRANE AIR BARRIERS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section Includes:

- 1. Vapor-retarding, fluid-applied air barriers (air and vapor barrier).

- B. Related Sections include the following:

- 1. Division 4 Section "Unit Masonry" for masonry walls to receive air and vapor barrier.
 - 2. Division 6 Section "Sheathing" for exterior gypsum sheathing to receive air and vapor barrier.
 - 3. Division 7 Section "Thermoplastic Polyolefin (TPO) Roofing" for roof vapor retarder.
 - 4. Division 7 Section "Joint Sealants" for joint-sealant materials and installation.

1.03 DEFINITIONS

- A. Air-Barrier Material: A primary element that provides a continuous barrier to the movement of air.
- B. Air-Barrier Accessory: A transitional component of the air barrier that provides continuity.
- C. Air-Barrier Assembly: The collection of air-barrier materials and accessory materials applied to an opaque wall, including joints and junctions to abutting construction, to control air movement through the wall.

1.04 REFERENCES

- A. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components.

1.05 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site prior to substrate installation.
 - 1. Review air-barrier requirements and installation, special details, mockups, air-leakage and bond testing, air-barrier protection, and work scheduling that covers air barriers.
 - 2. Include installers of other construction connecting to air barrier, such as roofing, waterproofing, masonry, joint sealants, windows, and door frames.
 - 3. Review air barrier requirements including surface preparation, substrate condition and pretreatment, minimum substrate curing period, forecasted weather conditions, special details and sheet flashings, mockups, installation procedures, sequence of installation, testing and inspecting procedures, and protection and repairs.

1.06 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include manufacturer's written instructions for evaluating, preparing, and treating each substrate; technical data; dry film thickness; and tested physical and performance properties of products.
 - 2. Certification by the manufacturer that products supplied comply with the Commonwealth of Massachusetts regulations controlling use of volatile organic compounds (VOCs).
- B. Shop Drawings: For air-barrier assemblies.
 - 1. Show locations and extent of air-barrier materials, accessories, and assemblies specific to Project conditions.
 - 2. Include details for substrate joints and cracks, counterflashing strips, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.
 - 3. Include details of interfaces with other materials that form part of air barrier.
 - 4. Include details specific to this Project; generic details are not permitted.
- C. Samples: For the following products:
 - 1. 12-by-12-inch square of fluid applied membrane.
 - 2. 12-by-12-inch square of transition tape.

1.07 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer. Include list of ABAA-certified installers and supervisors employed by Installer, who work on Project.

- B. Product Test Reports: From a qualified independent testing agency indicating and interpreting test results of air and vapor barrier system for compliance with requirements, based on comprehensive testing of current air and vapor barrier system formulations.
 - 1. Submit test results for air permeance in accordance with ASTM E 2178.
 - 2. Submit test results for air leakage volume testing in accordance with ASTM E 2357.
- C. Research/Evaluation Reports: From ICC-ES.
- D. Sample Warranty: Copy of special air and vapor barrier system manufacturer's warranty stating obligations, remedies, limitations, and exclusions before starting air and vapor barrier system.

1.08 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
 - 1. Installer shall be licensed by ABAA according to ABAA's Quality Assurance Program and shall employ ABAA-certified installers and supervisors on Project.
 - 2. Provide list of at least three (3) projects completed by the Installer within the past five (5) years of similar scope and complexity to this Project.
 - 3. Installer must show evidence of adequate equipment and trained field personnel to successfully complete project.
- B. Mockups: Build mockups to set quality standards for materials and execution, and for preconstruction testing.
 - 1. Build integrated mockups of exterior wall assembly as directed by Architect, 150 sq. ft., incorporating each type of backup wall construction, external cladding, window, door frame and sill, insulation, ties and other penetrations, and flashing to demonstrate surface preparation, crack and joint treatment, application of air barriers, and sealing of gaps, terminations, and penetrations of air-barrier assembly.
 - a. Coordinate construction of mockups to permit inspection by Owner's testing agency of air barrier before external insulation and cladding are installed.
 - b. Include junction with roofing membrane, building corner condition, and foundation wall intersection.
 - c. If Architect determines mockups do not comply with requirements, reconstruct mockups and apply air barrier until mockups are approved.

2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.09 DELIVERY, STORAGE, AND HANDLING

- A. Deliver liquid materials to Project site in original containers with seals unbroken, labeled with manufacturer's name, product brand name and type, date of manufacture, shelf life, and directions for storing and mixing with other components.
- B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by air and vapor barrier system manufacturer. Do not double stack pallets of materials.
- C. Remove and replace liquid materials that cannot be applied within their stated shelf life.
- D. Protect stored materials from direct sunlight, extreme heat, and freezing.

1.10 PROJECT CONDITIONS

- A. Environmental Limitations: Apply air and vapor barrier system within the range of ambient and substrate temperatures recommended by air and vapor barrier system manufacturer, but at not less than 40 deg F. Do not apply air and vapor barrier system to a damp or wet substrate, when relative humidity exceeds 85 percent, or when temperatures are less than 5 deg F above dew point.
 1. Do not apply air and vapor barrier system in snow, rain, fog or mist, or when such weather conditions are imminent during application and curing period.
- B. Maintain adequate ventilation during application and curing of air and vapor barrier system materials.

1.11 WARRANTY

- A. Special Manufacturer's Warranty: Written warranty, signed by air and vapor barrier system manufacturer agreeing to repair or replace air and vapor barrier system that does not comply with requirements or that does not remain watertight within specified warranty period.
 1. Warranty does not include failure of air and vapor barrier system due to failure of substrate prepared and treated according to requirements or formation of new joints and cracks in substrate that exceed 1/16 inch in width.
 2. Warranty Period: Five years from date of Substantial Completion.

3. Warranty Period for Material Only: 10 years from date of Substantial Completion.
- B. Installer Warranty: Written warranty, signed by Installer agreeing to repair or replace materials installed according to manufacturer's written recommendations, that fails in performance, materials, or workmanship within specified warranty period.
 1. Warranty Period: Three years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 MATERIALS, GENERAL

- A. Source Limitations: Obtain air and vapor barrier system materials through one source from a single manufacturer.
- B. VOC Content: 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24) and complying with VOC content limits of authorities having jurisdiction.

2.02 PERFORMANCE REQUIREMENTS

- A. Air-Barrier Performance: Air-barrier assembly and seals with adjacent construction shall be capable of performing as a continuous air barrier and as a liquid-water drainage plane flashed to discharge to the exterior incidental condensation or water penetration. Air-barrier assemblies shall be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, penetrations, tie-ins to installed waterproofing, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.
- B. Air-Barrier Assembly Air Leakage: Maximum 0.04 cfm/sq. ft. of surface area at 1.57 lbf/sq. ft. (0.2 L/s x sq. m of surface area at 75 Pa), when tested according to ASTM E 2357.
- C. UV Resistance: Can be exposed to sunlight for 90 days according to manufacturer's written instructions.
- D. Low Temperature Installation: Provide products suitable for low temperature installation as required by construction schedule. Apply air and vapor barrier system within the range of ambient and substrate temperatures recommended by air and vapor barrier system manufacturer, but at not less than 25 deg F.
- E. Fire Performance Characteristics: Provide water-resistive barrier meeting the following fire-test characteristics.

1. Surface-Burning Characteristics: ASTM E 84.
 - a. Flame spread index: 25 or less
 - b. Smoke developed index: 450 or less
- F. Provide vapor-retarding membrane air barrier compatible with exterior wall insulation specified in Division 7 Section "Thermal Insulation" that has also been tested in an assembly with the insulation in accordance with NFPA 285.

2.03 VAPOR-RETARDING MEMBRANE AIR BARRIER

- A. Fluid-Applied, Vapor-Retarding Membrane Air Barrier: Elastomeric, synthetic polymer membrane.
 1. Basis of Design Product: Subject to compliance with requirements, provide **Henry Company; Air-Bloc 16MR** or one of the following:
 - a. Carlisle Coatings and Waterproofing, Inc.; Fire Resist Barritech NP.
 - b. GCP Applied Technologies; Perm-A-Barrier NPL 10.
 - c. W.R. Meadows; Air-Shield LSR.
- B. Fluid-Applied, Vapor-Retarding Membrane Air Barrier: Elastomeric, synthetic polymer membrane for low temperature installation:
 1. Basis of Design Product: Subject to compliance with requirements, provide **Henry Company; Air-Bloc 16MR** or one of the following:
 - a. Carlisle Coatings and Waterproofing, Inc.; Fire Resist Barritech NP-LT.
 - b. GCP Applied Technologies; Perm-A-Barrier NPL 10 LT.
 - c. W.R. Meadows; Air-Shield LSR.
- C. Fluid-Applied air and vapor barrier system: Comply with manufacturer's written physical requirements, and performance requirements as follows:
 1. Vapor Permeance: Maximum 0.1 perm; ASTM E 96/E 96M.
 2. Air Permeance: Maximum 0.004 cfm/sq. ft. of surface area at 1.57-lbf/sq. ft. pressure difference (0.02L/s*m² at 75 Pa); ASTM E 2178.
 3. Low Temperature Flexibility: ASTM D 1970, unaffected to -45 deg F.
 4. Elongation: ASTM D 412, Die C, minimum 500%.

2.04 ACCESSORY MATERIALS

- A. General: Accessory materials recommended by air-barrier manufacturer to produce a complete air-barrier assembly and compatible with primary air-barrier material.

- B. Primer: Liquid waterborne primer recommended for substrate by air-barrier material manufacturer.
- C. Transition Membrane: Manufacturer's standard, vapor retarding, smooth surfaced, modified bitumen, self-adhering sheet membrane complete with an engineered thermoplastic film.
 - 1. Membrane Thickness: 40 mils minimum.
- D. Joint Reinforcing Strip: Air-barrier manufacturer's glass-fiber-mesh tape.
- E. Substrate-Patching Membrane: Manufacturer's standard trowel-grade substrate filler.
- F. Adhesive: Air-barrier manufacturer's standard adhesive.
- G. Termination Sealant: Air-barrier manufacturer's standard moisture cure, medium modulus polymer modified sealing compound.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance.
 - 1. Verify that substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
 - 2. Verify that masonry joints are flush and completely filled with mortar.
 - 3. Proceed with installation only after unsatisfactory conditions have been corrected. Commencement of work indicates acceptance of substrates.

3.02 SURFACE PREPARATION

- A. Clean and prepare substrate according to manufacturer's written recommendations. Provide clean, dust-free, and dry substrate for air and vapor barrier system application.
- B. Mask off adjoining surfaces not receiving air and vapor barrier system to prevent spillage or overspray affecting other construction.
- C. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids in concrete with substrate-patching material.
- D. Remove excess mortar from masonry ties, shelf angles, and other obstructions.
- E. At changes in substrate plane, apply sealant or termination mastic beads at sharp corners and edges to form a smooth transition from one plane to another.

- F. Cover gaps in substrate plane and form a smooth transition from one substrate plane to another with stainless-steel sheet mechanically fastened to structural framing to provide continuous support for air barrier.
- G. Bridge isolation joints, expansion joints and discontinuous wall-to-wall, deck-to-wall, and deck-to-deck joints with air-barrier accessory material that accommodates joint movement according to manufacturer's written instructions and details.

3.03 JOINT TREATMENT

- A. Masonry: Prepare, treat, rout, and fill joints and cracks in substrate according to ASTM C 1193 and air barrier manufacturer's written instructions. Remove dust and dirt from joints and cracks complying with ASTM D 4258 before coating surfaces.
 - 1. Prime substrate and apply a single thickness of preparation coat strip extending a minimum of 3 inches along each side of joints and cracks. Apply a double thickness of air barrier membrane and embed a joint reinforcing strip in preparation coat.
- B. Gypsum Sheathing: Apply first layer of fluid air-barrier material at joints. Tape joints with joint reinforcing strip after first layer is dry. Apply a second layer of fluid air-barrier material over joint reinforcing strip.
 - 1. Fill joints greater than 1/4 inch with sealant according to ASTM C 1193 and air-barrier manufacturer's written instructions.

3.04 TRANSITION STRIP INSTALLATION

- A. Install transition strips and auxiliary materials according to air barrier manufacturer's written instructions to form a seal with adjacent construction and maintain a continuous air barrier.
 - 1. Coordinate the installation of air barrier with installation of roofing membrane and base flashing to ensure continuity of air barrier with roofing membrane.
 - 2. Install modified bituminous strip on roofing membrane or base flashing so that a minimum of 3 inches of coverage is achieved over both substrates.
- B. Apply primer to substrates at required rate and allow to dry. Limit priming to areas that will be covered by air barrier sheet in same day. Reprime areas exposed for more than 24 hours.
- C. Connect and seal exterior wall air barrier membrane continuously to roofing membrane air barrier, concrete below-grade structures, floor-to floor construction, exterior glazing and window systems, glazed curtain-wall systems, storefront systems, exterior louvers, exterior door framing, and other construction used in exterior wall openings, using accessory materials as indicated.

- D. At end of each working day, seal top edge of strips and transition strips to substrate with termination mastic.
- E. Apply joint sealants forming part of air barrier assembly within manufacturer's recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.
- F. Wall Openings: Prime concealed perimeter frame surfaces of windows, curtain walls, storefronts, and doors. Apply modified bituminous transition strip so that a minimum of 3 inches of coverage is achieved over both substrates. Maintain 3 inches of full contact over firm bearing to perimeter frames with not less than 1 inch of full contact.
 - 1. Modified Bituminous Transition Membrane: Roll firmly to enhance adhesion.
 - a. Apply adhesive to wall, frame, and flashing sheet. Install flashing sheet and termination bars, fastened at 6 inches o.c. Apply lap sealant over exposed edges and on cavity side of flashing sheet.
 - 2. Provide flashing, as detailed, over window base shims and upturned sides and back face of window units.
- G. Fill gaps in perimeter frame surfaces of windows, curtain walls, storefronts, and doors, and miscellaneous penetrations of air barrier membrane with foam sealant.
- H. Seal transition strips around masonry reinforcing or ties and penetrations with termination mastic.
- I. Seal top of through-wall flashings to air barrier with an additional 6-inch- wide, modified bituminous strip.
- J. Seal exposed edges of strips at seams, cuts, penetrations, and terminations not concealed by metal counterflashings or ending in reglets with termination mastic.
- K. Repair punctures, voids, and deficient lapped seams in strips and transition strips. Slit and flatten fishmouths and blisters. Patch with transition strips extending 6 inches beyond repaired areas in strip direction.

3.05 FLUID AIR-BARRIER MEMBRANE INSTALLATION

- A. General: Apply fluid air-barrier material to form a seal with strips and transition strips and to achieve a continuous air barrier according to air-barrier manufacturer's written instructions. Apply fluid air-barrier material within manufacturer's recommended application temperature ranges.
 - 1. Unless manufacturer recommends in writing against priming, apply primer to substrates at required rate and allow it to dry.

2. Limit priming to areas that will be covered by air-barrier material on same day. Reprime areas exposed for more than 24 hours.
 3. Where multiple prime coats are needed to achieve required bond, allow adequate drying time between coats.
 4. Install air barrier membrane prior to installation of masonry veneer anchors.
 5. Protect in place masonry veneer anchor pintels.
- B. Membrane Air Barriers: Apply a continuous unbroken air-barrier membrane to substrates according to the following thickness. Apply air-barrier membrane in full contact around protrusions such as masonry ties.
1. Vapor-Retarding Membrane Air Barrier: Provide total dry or wet film thickness for each type of substrate as recommended in writing by manufacturer to meet specified performance requirements, applied in one coat, but not less than 40 mils dry.
- C. Start installing air and vapor barrier system in presence of manufacturer's technical representative.
- D. Mix materials and apply air and vapor barrier system by spray application method.
1. Apply air and vapor barrier system to prepared wall terminations and vertical surfaces using a cross-hatching technique to ensure coverage and thickness.
 2. Carry membrane into any opening a minimum of 2-inches.
 3. Seal all masonry ties and other penetrations as work progresses.
 4. Verify wet film thickness of air and vapor barrier system every 100 sq. ft.
- E. Allow the fluid applied membrane to cure to tack-free and apply transition membrane with a minimum 3-inch overlap onto each surface at all beams, columns and joints as indicated in detail shop drawings.
1. Tie-in to window and door frames, roof and floor intersections and changes in substrate.
 2. Overlap adjacent pieces 2-inches and roll all seams with a hand roller.
 3. Seal top edge of flashing with a termination mastic.
- F. Do not cover air barrier until it has been tested and inspected by Owner's testing agency.
- G. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air barrier components.
- 3.06 FIELD QUALITY CONTROL
- A. ABAA Quality Assurance Program: Perform examinations, preparation, installation, testing, and inspections under ABAA's Quality Assurance Program.

- B. Inspections: Air barrier materials and installation are subject to inspection for compliance with requirements. Inspections may include the following:
1. Continuity of air barrier system has been achieved throughout the building envelope with no gaps or holes.
 2. Continuous structural support of air barrier system has been provided.
 3. Masonry and concrete surfaces are smooth, clean and free of cavities, protrusions, and mortar droppings.
 4. Site conditions for application temperature and dryness of substrates have been maintained.
 5. Maximum exposure time of materials to UV deterioration has not been exceeded.
 6. Surfaces have been primed, if applicable.
 7. Laps in strips and transition strips have complied with minimum requirements and have been shingled in the correct direction (or mastic has been applied on exposed edges), with no fishmouths.
 8. Termination mastic has been applied on cut edges.
 9. Strips and transition strips have been firmly adhered to substrate.
 10. Compatible materials have been used.
 11. Transitions at changes in direction and structural support at gaps have been provided.
 12. Connections between assemblies (membrane and sealants) have complied with requirements for cleanliness, preparation and priming of surfaces, structural support, integrity, and continuity of seal.
 13. All penetrations have been sealed.
- C. Tests: As determined by testing agency from among the following tests:
1. Quantitative Air-Leakage Testing: Air-barrier assemblies will be tested for air leakage according to ASTM E 783.
 2. Adhesion Testing: Air-barrier assemblies will be tested for required adhesion to each substrate according to ASTM D 4541 for each 1000 sq. ft. of installed air barrier or part thereof.
- D. Air barriers will be considered defective if they do not pass tests and inspections.
1. Apply additional air-barrier material, according to manufacturer's written instructions, where inspection results indicate insufficient thickness.
 2. Remove and replace deficient air-barrier components for retesting as specified above.
- E. Repair damage to air barriers caused by testing; follow manufacturer's written instructions.

3.07 CURING, PROTECTING, AND CLEANING

- A. Cure air and vapor barrier system according to manufacturer's written recommendations, taking care to prevent contamination and damage during application stages and curing.
- B. Protect air and vapor barrier system from damage and wear during remainder of construction period.
- C. Protect installed air and vapor barrier system from damage due to ultraviolet light, harmful weather exposures, physical abuse, and other causes. Provide temporary coverings where air and vapor barrier system will be subject to abuse and cannot be concealed and protected by permanent construction within 30 days after installation.
- D. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION

SECTION 07275

WATER-RESISTIVE AIR-BARRIER MEMBRANES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section includes vapor-permeable air-barrier membranes.
- B. Related Requirements:
 - 1. Division 07 Section "Thermal Insulation" for mineral wool insulation.

1.03 DEFINITIONS

- A. Air-Barrier Material: A primary element that provides a continuous barrier to the movement of air.
- B. Air-Barrier Accessory: A transitional component of the air barrier that provides continuity.
- C. Air-Barrier Assembly: The collection of air-barrier materials and accessory materials applied to an opaque wall, including joints and junctions to abutting construction, to control air movement through the wall.

1.04 REFERENCES

- A. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components.

1.05 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1. Review air-barrier requirements and installation, special details, mockups, air-leakage and bond testing, air-barrier protection, and work scheduling that covers air barriers.

1.06 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 1. Include manufacturer's written instructions for evaluating, preparing, and treating substrate; technical data; and tested physical and performance properties of products.
 2. Submit documentation from an approved independent testing laboratory certifying the membrane meets ICC-ES AC308 - Acceptance Criteria for Water-Resistive Barriers.
- B. Shop Drawings: For air-barrier assemblies.
 1. Show locations and extent of air barrier. Include details for substrate joints and cracks, counterflashing, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.
 2. Include details of interfaces with other materials that form part of air barrier.

1.07 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer. Include list of ABAA-certified installers and supervisors employed by the Installer, who work on Project.
- B. Product Certificates: From air-barrier manufacturer, certifying compatibility of air barriers and accessory materials with Project materials that connect to or that come in contact with the barrier.
- C. Product Test Reports: For each air-barrier assembly, for tests performed by a qualified testing agency.
- D. Warranty: Special warranty included in this Section.

1.08 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
 1. Installer shall be licensed by ABAA according to ABAA's Quality Assurance Program and shall employ ABAA-certified installers and supervisors on Project.
 2. Provide list of at least three (3) projects completed by the Installer within the past five (5) years of similar scope and complexity to this Project.

3. Installer must show evidence of adequate equipment and trained field personnel to successfully complete project.

B. Mockups: Build mockups to set quality standards for materials and execution.

1. Build integrated mockups of exterior wall assembly as directed by Architect incorporating backup wall construction, external cladding, window, storefront, door frame and sill, insulation, ties and other penetrations, and flashing to demonstrate surface preparation, crack and joint treatment, application of air barriers, and sealing of gaps, terminations, and penetrations of air-barrier assembly.
 - a. Coordinate construction of mockups to permit inspection by Owner's testing agency of air barrier before external insulation and cladding are installed.
 - b. Include junction with roofing membrane, building corner condition, and foundation wall intersection.
 - c. If Architect determines mockups do not comply with requirements, reconstruct mockups and apply air barrier until mockups are approved.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.09 DELIVERY, STORAGE, AND HANDLING

- A. Remove and replace liquid materials that cannot be applied within their stated shelf life.
- B. Protect stored materials from direct sunlight.

1.10 FIELD CONDITIONS

- A. Environmental Limitations: Apply air barrier within the range of ambient and substrate temperatures recommended by air-barrier manufacturer.
 1. Protect substrates from environmental conditions that affect air-barrier performance.
 2. Do not apply air barrier to a damp or wet substrate or during snow, rain, fog, or mist.

1.11 WARRANTY

- A. Special Manufacturer's Warranty: Written warranty, signed by air-barrier system manufacturer agreeing to repair or replace self-adhered water-resistive vapor permeable air-barrier system that does not comply with requirements or that does not remain watertight within specified warranty period.
 - 1. Warranty Period: 10 years from date of Substantial Completion.
- B. Installer Warranty: Written warranty, signed by Installer agreeing to repair or replace materials installed according to manufacturer's written recommendations, that fails in performance, materials, or workmanship within specified warranty period.
 - 1. Warranty Period: Three years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 MATERIALS, GENERAL

- A. Source Limitations: Obtain primary air-barrier materials and air-barrier accessories from single source from single manufacturer.
- B. VOC Content: 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24) and complying with VOC content limits of authorities having jurisdiction.
- C. Fire Performance Characteristics: Provide water-resistive barrier meeting the following fire-test characteristics.
 - 1. Surface-Burning Characteristics: ASTM E 84.
 - a. Flame spread index: 25 or less
 - b. Smoke developed index: 450 or less

2.02 PERFORMANCE REQUIREMENTS

- A. General: Air barrier shall be capable of performing as a continuous vapor-permeable air barrier and as a liquid-water drainage plane flashed to discharge to the exterior incidental condensation or water penetration. Air-barrier assemblies shall be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, penetrations, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.
- B. Air-Barrier Assembly Air Leakage: Maximum 0.04 cfm/sq. ft. of surface area at 1.57 lbf/sq. ft., when tested according to ASTM E 2357.

2.03 VAPOR-PERMEABLE, AIR-BARRIER MEMBRANE

- A. Vapor-Permeable Non-Bituminous Sheet: Tear resistant polyester substrate with a highly UV-stabilized acrylic coating, including factory applied self-adhesive strip at longitudinal edges.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide **VaproShield LLC; RevealShield IT** or the following:
 - a. Cosella-Dörken Products, Inc.; Delta-Fassade S.
 - 2. Physical and Performance Properties:
 - a. Color: Black with allowable UV exposure for 180 days total before being covered by cladding.
 - b. Air Leakage: < 0.00004 cfm/sq.ft. (0.0002 L/s/sq.m) when tested in accordance with ASTM E 2178 and < 0.000034 cfm/sq.ft. (0.00017 L/s/sq.m) when tested in accordance with ASTM E 283.
 - c. Water Vapor Permeance tested to ASTM E 96 Method B: 42 perms (262.6 g/m²)
 - d. Water Resistance tested to AATCC 127, 550 mm hydrostatic head for 5 hours: No leakage
 - e. Tensile Strength tested to ASTM D 828: 44.8 lbf/inch (68 N/mm), machine direction; 21.3 lbf/inch (37.3 N/mm), cross-machine direction
 - f. Application Temperature: No temperature restrictions
 - g. Surface Burning Characteristics tested to ASTM E 84: Class A, Flame-spread index of less than 10, Smoke-development index of less than 135
 - h. Physical Dimensions: 0.020 inches (0.51 mm) thick and 59 inches (1.5 m) wide and 5 oz per sq. yd. (170 g/sq. m).

2.04 ACCESSORY MATERIALS

- A. General: Accessory materials recommended by air-barrier manufacturer to produce a complete air-barrier assembly and compatible with primary air-barrier material.
- B. Water-Resistive Air Barrier Sheet Membrane Fasteners:
 - 1. Water-resistive air barrier sheet membrane fasteners shall be corrosion-resistant or stainless steel screws of #6, 7, or 8, bugle-head design.
 - 2. Screw head caps for water-resistive air barrier sheet membrane shall be VaproCaps by VaproShield, a 1¾ inch diameter preformed head caps with a center throat hole that seals the membrane at the fastener penetration, specifically designed and tested to withstand wind loads and protect against water intrusion at screw penetrations.

3. Selection of fastener thread type is subject to sheathing board and substrate type. Manufacturer recommends subcontractor to supply and place corrosion-resistant or stainless steel screws sized to penetrate gypsum sheathing board through to solid backing or steel studs or wood sheathing by $\frac{3}{4}$ inch in conjunction with preformed screw head caps.
- C. Water-Resistive Air Barrier Seam and Joint Sealant: Silicone, compatible with sheet membrane.
- D. Water-Resistive Air Barrier Transition and Flashing Membranes:
1. Mechanically attached air barrier transition and flashing membrane shall be RevealFlashing™ by VaproShield, a Black, highly UV stable, zero VOC mechanically attached water-resistive vapor permeable membrane having the following properties:
 - a. RevealFlashing™: 6 1/2 inches or 11 3/4- inches wide x 164 feet long
 - b. Air Leakage: < 0.0000263 cfm/sq. ft. @ 75 Pa (0.000134 L/s/m sq @ 75 Pa) when tested in accordance with ASTM E 2178
 - c. Water Vapor Permeance tested to ASTM E 96 Method B: 42 perms (2875ng/Pa.s.m²)
 - d. Water Resistance tested to AATCC 127, 550 mm hydrostatic head for 5 hours: No leakage.
- E. Water-Resistive Flashing for Rough Openings:
1. Window and door flashing shall be VaproLiqui-Flash by VaproShield, a liquid-applied vapor permeable air barrier flashing material with vapor permeance and resistance to air leakage properties compatible with the primary air barrier membrane.
- F. Water-Resistive Flashing and Penetration Tapes:
1. Tapes shall be VaproTape™ by VaproShield: UV stable, single sided, moisture-resistant flexible tape with adhesive backing, tested for compatibility with VaproShield products, having the following properties:
 - a. VaproTape UV-Resistant Black: 35 mil thick by 4 inches (102 mm) wide penetration seam tape
 - b. VaproAlumaTape: 20 mil thick by 4.5 inches (114 mm) and 9 inches (229 mm) wide, foil faced, UV stable, moisture-resistant flashing and membrane transition tape for use with silicone sealants

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
 - 1. Verify that substrates are sound and free of oil, grease, dirt, excess mortar, or other contaminants.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 SURFACE PREPARATION

- A. Clean, prepare, treat, and seal substrate according to manufacturer's written instructions. Provide clean, dust-free, and dry substrate for air-barrier application.
- B. Mask off adjoining surfaces not covered by air barrier to prevent spillage and overspray affecting other construction.
- C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.
- D. At changes in substrate plane, apply sealant or termination mastic beads at sharp corners and edges to form a smooth transition from one plane to another.
- E. Cover gaps in substrate plane and form a smooth transition from one substrate plane to another with stainless-steel sheet mechanically fastened to structural framing to provide continuous support for air barrier.

3.03 JOINT TREATMENT

- A. Gypsum Sheathing: Fill joints greater than 1/4 inch with sealant according to ASTM C 1193 and air-barrier manufacturer's written instructions. Apply first layer of air-barrier coating material at joints. Tape joints with joint reinforcing after first layer is dry. Apply a second layer of air-barrier coating material over joint reinforcing.

3.04 TRANSITION STRIP INSTALLATION

- A. General: Install strips, transition strips, and accessory materials according to air-barrier manufacturer's written instructions to form a seal with adjacent construction and maintain a continuous air barrier.

1. Coordinate the installation of air barrier with installation of roofing membrane and base flashing to ensure continuity of air barrier with roofing membrane.
 2. Install transition strip on roofing membrane or base flashing so that a minimum of 3 inches of coverage is achieved over each substrate.
- B. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by air-barrier coating material on same day. Reprime areas exposed for more than 24 hours.
- C. Connect and seal exterior wall air-barrier material continuously to roofing-membrane air barrier, concrete below-grade structures, floor-to-floor construction, exterior glazing and window systems, glazed curtain-wall systems, storefront systems, exterior louvers, exterior door framing, and other construction used in exterior wall openings, using accessory materials.
- D. At end of each working day, seal top edge of strips and transition strips to substrate with termination mastic.
- E. Apply joint sealants forming part of air-barrier assembly within manufacturer's recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.
- F. Wall Openings: Prime concealed, perimeter frame surfaces of windows, curtain walls, storefronts, and doors. Apply transition strip so that a minimum of 3 inches of coverage is achieved over each substrate. Maintain 3 inches of full contact over firm bearing to perimeter frames with not less than 1 inch of full contact.
1. Elastomeric Flashing Sheet: Apply adhesive to wall, frame, and flashing sheet. Install flashing sheet and termination bars, fastened at 6 inches o.c. Apply lap sealant over exposed edges and on cavity side of flashing sheet.
- G. Fill gaps in perimeter frame surfaces of windows, curtain walls, storefronts, and doors, and miscellaneous penetrations of air-barrier material with foam sealant.
- H. Seal strips and transition strips around masonry reinforcing or ties and penetrations with termination mastic.
- I. Seal exposed edges of strips at seams, cuts, penetrations, and terminations not concealed by metal counterflashings or ending in reglets with termination mastic.
- J. Repair punctures, voids, and deficient lapped seams in strips and transition strips. Slit and flatten fishmouths and blisters. Patch with transition strips extending 6 inches beyond repaired areas in strip direction.

3.05 VERTICAL APPLICATIONS

- A. For vertical applications, align sheets with an ‘inside’ or ‘outside’ corner to avoid wrinkles and miss-alignment of subsequent applications.
- B. Measure and pre-cut into manageable sized self-adhered sheets to suit the application conditions.
- C. Hang sheets over wall and extend down to lowest point of wall. Allow for excess material at bottom of wall to accommodate tie-ins and connections to adjacent surfaces.

3.06 BATTENS AND VENTILATION STRIPS FOR RAIN SCREEN CLADDING SYSTEMS

- A. Provide and install specified battens and ventilation strips under cladding systems.
- B. Install horizontal starter strip or vent strip at base of wall, vertical battens and top vent strip, secure into solid backing ready for installation of cladding system.
- C. Coordinate spacing of battens and vent strips to accommodate cladding system.

3.07 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Inspections: Air-barrier materials, accessories, and installation are subject to inspection for compliance with requirements. Inspections shall include the following:
 - 1. Continuity of air-barrier system has been achieved throughout the building envelope with no gaps or holes.
 - 2. Continuous structural support of air-barrier system has been provided.
 - 3. Masonry and concrete surfaces are smooth, clean, and free of cavities, protrusions, and mortar droppings.
 - 4. Site conditions for application temperature and dryness of substrates have been maintained.
 - 5. Maximum exposure time of materials to UV deterioration has not been exceeded.
 - 6. Surfaces have been primed, if applicable.
 - 7. Laps in strips and transition strips have complied with minimum requirements and have been shingled in the correct direction (or mastic has been applied on exposed edges), with no fishmouths.
 - 8. Termination mastic has been applied on cut edges.
 - 9. Strips and transition strips have been firmly adhered to substrate.
 - 10. Compatible materials have been used.
 - 11. Transitions at changes in direction and structural support at gaps have been provided.

12. Connections between assemblies (air-barrier and sealants) have complied with requirements for cleanliness, surface preparation and priming, structural support, integrity, and continuity of seal.
13. All penetrations have been sealed.

C. Tests:

1. Quantitative Air-Leakage Testing: Air-barrier assemblies will be tested for air leakage according to ASTM E 783.
2. Adhesion Testing: Air-barrier assemblies will be tested for minimum air-barrier adhesion of 30 lbf/sq. in. according to ASTM D 4541 for each 600 sq. ft. of installed air barrier or part thereof.

D. Air barriers will be considered defective if they do not pass tests and inspections.

1. Apply additional air-barrier material, according to manufacturer's written instructions, where inspection results indicate insufficient thickness.
2. Remove and replace deficient air-barrier components for retesting as specified above.

E. Repair damage to air barriers caused by testing; follow manufacturer's written instructions.

3.08 CLEANING AND PROTECTION

A. Protect air-barrier system from damage during application and remainder of construction period, according to manufacturer's written instructions.

1. Protect air barrier from exposure to UV light and harmful weather exposure as required by manufacturer. If exposed to these conditions for more than [30] [60] <Insert number> days, remove and replace air barrier or install additional, full-thickness, air-barrier application after repairing and preparing the overexposed membrane according to air-barrier manufacturer's written instructions.
2. Protect air barrier from contact with incompatible materials and sealants not approved by air-barrier manufacturer.

B. Clean spills, stains, and soiling from construction that would be exposed in the completed work using cleaning agents and procedures recommended by manufacturer of affected construction.

C. Remove masking materials after installation.

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 07421

COMPOSITE FRAMING SUPPORT SYSTEM

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section Includes:

- 1. Composite framing support (CFS) system.

- B. Related Requirements:

- 1. Division 4 Section "Unit Masonry."
 - 2. Division 5 Section "Cold Formed Metal Framing."
 - 3. Division 6 Section "Sheathing" for exterior gypsum sheathing.
 - 4. Division 7 Section "Thermal Insulation" for rainscreen insulation.
 - 5. Division 7 Section "Fluid-Applied Membrane Air Barriers" for membrane air barrier.
 - 6. Division 7 Section "High Performance GFRC Wall Panels."

1.03 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.05 COORDINATION

- A. Coordination: Coordinate construction of wall cladding support system over substrate indicated for proper drainage, flashing, trim, back-up support, soffits, and other related Work.

- 1. Review and finalize construction schedule.
 - 2. Verify availability of materials, installer's personnel, equipment, and facilities needed to maintain schedule.
 - 3. Review means and methods related to installation, including manufacturer's written instructions.

4. Examine support conditions for compliance with requirements, including alignment and attachment to structural support system.
5. Review flashings, wall cladding details, wall penetrations, openings, and condition of other construction that affects this Work.
6. Review temporary protection requirements for during and after installation of this Work.

1.06 ACTION SUBMITTALS

- A. Product Data: For each type of framing product and accessory.
- B. Shop Drawings:
 1. Plans, elevations, framed openings, bearing, details, thermal isolation, fasteners, connectors and anchorage devices, and attachments as needed for project execution.
 2. Interface of cold-formed assembly with adjacent construction.
 3. For non-load-bearing metal framing indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional structural engineer licensed in the Commonwealth of Massachusetts responsible for their preparation.
- C. Samples: Two each of components and fasters for system assembly.
- D. Delegated-Design Submittal: For framing assembly.
 1. Design Calculations: Comprehensive analysis of design loads, including dead loads, live loads, wind loads, and thermal movement.

1.07 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency and professional structural engineer.
- B. Test and Inspection Reports: Submit test and inspection reports on each type of wall cladding/veneer system based on evaluation of comprehensive tests performed by nationally recognized testing agency.
- C. Warranty: Special warranty included in this Section.

1.08 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Able to document minimum three years' experience designing and supplying work of this Section.

- B. Professional Structural Engineer Qualifications: A professional structural engineer who is legally qualified to practice in the Commonwealth of Massachusetts and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations that are similar to those indicated for this Project in material, design, and extent.
- C. Installer Qualifications:
 - 1. Trained and authorized by manufacturer as qualified to install work of this Section.
 - 2. Employ full-time on-site superintendent or foreman to overseeing installation during work of this Section.
 - 3. Submit successfully completed projects of equivalent scope and quality upon request by Architect.
- D. Single source responsibility: Furnish all thermal and air barrier system components from a single manufacturer to avoid compatibility and performance issues.
 - 1. Furnish all engineered façade attachment/support framing system components under direct responsibility of single manufacturer to avoid performance issues.
 - 2. Manufacturer of thermal and air barrier system may differ from façade attachment/support framing system manufacturer.
- E. Mockups:
 - 1. Mock up complete system for each type of installation at location as directed by Architect.
 - 2. Provide as required to illustrate substrate, air barrier, insulation, framing, flashing, thermal isolation, and treatments at fenestrations, corners, and transitions.
 - 3. Verify mock-up as conforming to manufacturer's instructions and provisions of Contract Documents.
 - 4. Do not begin work of this Section until after inspection by manufacturer's representative is complete and mock-up has been accepted in writing by Architect.
 - 5. Protect and maintain accepted mock-up as standard of quality for work of this Section.
 - 6. Accepted mock-ups may be incorporated into the work of this Section.

1.09 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- B. Store and handle to keep clean, dry, and protected from damage due to weather and construction activities.

1.10 PROJECT CONDITIONS

- A. Field Measurements: Contractor is responsible for all field measurements, verifying actual supporting and adjoining construction before fabrication; record field measurements on project record shop drawings.
- B. Environmental Requirements: Undertake installation work only when weather conditions are in compliance with manufacturers' specific environmental requirements and when conditions will permit work to be performed in accordance with manufacturer recommendations and warranty requirements.

1.11 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace cold formed metal rainscreen framing system that fails in materials or workmanship within specified warranty period.
 - 1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional structural engineer, as defined in Division 1 Section "Quality Control," to design rainscreen framing system.
- B. Structural Performance: Provide cold-formed steel framing capable of withstanding design loads within limits and under conditions indicated.
 - 1. Design Loads: In accordance with the Massachusetts State Building Code and minimum design wind loads for components and cladding indicated on Structural Drawings.
 - a. Dead Loads: Design for loading to accommodate support of cladding systems, including formed metal wall panels and fiber reinforced cementitious panels.
 - b. Seismic Loads: Design and size components to withstand seismic load and sway displacement.
 - 2. Design framing systems to provide for movement of framing members located outside the insulated building envelope without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 deg F.

3. Design exterior non-load-bearing wall framing to accommodate lateral building drift and differential foundation settlement as indicated on Structural Drawings.
- C. Attachment System Performance: Constructed system shall comply with ANSI/ASHRAE 90.1-2010 definition of continuous insulation (c.i.).
1. No thermal bridges other than fasteners and service openings.
- D. Thermal Performance:
1. Full constructed assembly must have a minimum 95% effective R-value when compared to the exterior insulations rated R-Value.
 2. Continuous framing profiles penetrating insulation not allowed.
 3. Effective R-Value calculation or modeling must be done in accordance with ASHRAE guidelines.
- E. Cladding Accommodation: Design framing supports configuration, size, spacing, and make adjustments as needed to accommodate support for each cladding type.
- F. Rain Screen Design: Design ventilating system assembly to accommodate movement of air movement into the rain screen cavity and move water vapor out.
- G. Tolerances:
1. Accommodate deflection of structural members.
 2. Maintain clearances at adjacent construction.
 3. Prevent load transfer to non-structural elements.
 4. System allows vertical adjusting to make plumb and in alignment with adjacent construction as needed without the use of separate plastic shims or similar.
- H. Thermal Insulation: Rainscreen insulation as specified in Division 07 Section “Thermal Insulation.”
1. Design thickness and type of insulation into system assembly.
 2. Perform thermal analysis to determine framing systems effect on wall assembly.
- I. Fire Performance Evaluation as a component of an NFPA 285 approved wall assembly per the requirements of the Massachusetts State Building Code.
- 2.02 COMPOSITE FRAMING SUPPORT SYSTEM
- A. Attach CFS system components to exterior sheathing over metal stud framing, to masonry, and to concrete.

- B. Composite Framing Support (CFS) System: Provide CFS system consisting of polyester and vinyl ester bioresin matrix (FRP) with recycled materials, fire retardant additives and integral continuous metal inserts the length of profile. Reinforce CFS system with glass strand rovings used internally for longitudinal (lengthwise) strength and continuous strand glass mats or stitched reinforcements used internally for transverse (crosswise) strength.
1. Basis of Design Product: Subject to compliance with requirements, provide **Advanced Architectural Products; SMARTci GreenGirt 1-in-1 System** or comparable product by one of the following:
 - a. Armatherm.
 - b. Strongwell; Strongirt.
 2. Depth of Girt:
 - a. CMU Backup: 4 inches.
 - b. Concrete Backup: 2 inches.
 3. On Center Spacing: 16 inches.
 4. Provide continuous non-corrosive steel insert for engagement of fasteners, at least 16 gage thick with G90 galvanized coating designation in compliance with ASTM A653/A653M.
 - a. Fully engage steel insert with adjacent CFS at ends.
 - b. Anchor sub-girts and other wall cladding support accessories to steel insert set into and part of CFS.
 - c. Provide screw pullout testing that meets or exceeds 450 lbs.
 5. Provide integral compression seal in CFS sections to ensure insulation panel will not dislodge.
 6. Provide integral anti-siphon grooves on exterior and interior flanges of CFS.
 7. Provide force distribution zones integrally designed into profile of CFS.
- C. Physical Properties:
1. Surface Burning Characteristics:
 - a. Flame Spread Index (FSI): 25 or less, when tested in accordance with ASTM E84.
 - b. Smoke Developed Index (SDI): 450 or less, when tested in accordance with ASTM E84.
 2. Flammability: Comply with ASTM E84.
 3. Self-Extinguishing: Comply with ASTM D635.
 4. Profile Visual Requirements: Comply with ASTM D4385.

5. Tensile Stress: Provide engineered lengthwise and crosswise tensile stress in compliance with performance loading criteria and specified safety factors, in accordance with ASTM D638.
6. Compressive Stress: Provide engineered lengthwise and crosswise compressive stress in compliance with performance loading criteria and specified safety factors, in accordance with ASTM D695.
7. Flexural Stress: Provide engineered lengthwise and crosswise flexural stress in compliance with performance loading criteria and specified safety factors, in accordance with ASTM D790.
8. Modulus of Elasticity: Engineered to meet performance loading criteria and specified safety factors.
9. Barcol Hardness: 45, in accordance with ASTM D2583.
10. Water Absorption: Less than 0.46 percent by weight, within 24 hours, tested in accordance with ASTM D570.
11. Density: Within range of 0.062 to 0.070 lbs/cubic inch, in accordance with ASTM D792.
12. Lengthwise Coefficient of Thermal Expansion: 7.0×10^{-6} inch/inch/degrees F, in accordance with ASTM D696.
13. Notched Izod Impact, Lengthwise: 24 ft lbs/inch, in accordance with ASTM D256 within temperature range indicated.
14. Notched Izod Impact, Crosswise: 4 ft lbs/inch, in accordance with ASTM D256 within temperature range indicated.

2.03 ACCESSORIES

- A. Provide accessories necessary for complete CFS system including metal closure trim, transition angle, strapping, tie-in brackets and similar items.
- B. Fasteners: Corrosion-resistant, self-tapping and self-drilling screws, bolts, nuts, and other fasteners as recommended by CFS system manufacturer for project application.
 1. Cladding to CFS System: Use standard self-tapping metal screws.
 2. CFS System to Metal Stud Wall Framing: Use standard self-tapping metal screws.
 3. DO NOT USE powder, air, or gas actuated fasteners or actuated fastener tools. DO NOT USE impact wrenches when fastening to or from the CFS.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Backup Wall: Verify level and plumb, free of defects, and conforming to tolerances suitable for installation of subsequent work.

- B. Air / Water Barrier: Verify complete, cured, and conforming to manufacturer's instructions. Verify fenestrations, transitions, discontinuities, and sills and ledgers flashed and sealed to move moisture to exterior of building as part of air barrier system.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Review areas of potential interference and conflicts, and coordinate layout and support provisions for interfacing work.
- B. Prepare surfaces using methods recommended by CFS manufacturer for achieving best result for substrate under project conditions.
- C. Prepare sub-framing, base angles, sills, furring, and other CFS system members and provide anchorage in accordance with ASTM C754 for substrate type and wall cladding type in accordance with manufacturer's installation instructions.

3.03 INSTALLATION

- A. Install CFS system in accordance with manufacturer's installation instructions.
 - 1. Install girts horizontally at masonry and concrete backup walls.
 - 2. Install girts vertically on structural framing at roof level for direct attachment of high performance GFRC panels.
- B. Install system to fill-in exterior spaces without gaps or voids, and do not compress insulation panels.
- C. Trim insulation neatly to fit spaces, and insulate miscellaneous gaps and voids.
- D. Fit insulation tight in spaces and tight to exterior side of Mechanical/Electrical services within plane of insulation.
- E. Exposed insulation must be protected from open flame.
- F. Exterior wall insulation is not intended to be left exposed for extended periods of time without adequate protection.
- G. Install CFS system in compliance with system orientation, sizes, and locations as indicated on drawings.

3.04 ERECTION TOLERANCES

- A. Shim and align CFS system within installed tolerances of 1/4 inch in 20 feet, non-cumulative, level, plumb, and on location lines as indicated.

3.05 FIELD QUALITY CONTROL

- A. Manufacturer's Field Technical Service: Make intermittent and final inspection to verify installation in conformance to manufacturer instructions and suitable as framing assembly for subsequent cladding installations.
 - 1. Confirm snug tight and fastener sizing.
 - 2. Confirm framing members installed in correct orientation.
- B. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.06 ADJUSTING

- A. Protect installed products from damage until Date of Substantial Completion.
- B. Ensure that insulation panels are not exposed to moisture.
 - 1. Remove wet insulation panels or allow them to completely dry prior to installation of CFS system.
- C. Replace damaged insulation prior to Date of Substantial Completion.

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 07423

METAL COMPOSITE MATERIAL WALL PANELS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section includes:

- 1. Metal-faced composite wall and soffit panels.

- B. Related Sections:

- 1. Division 5 Section "Cold Formed Metal Framing" for exterior metal framing.
- 2. Division 6 Section "Sheathing" for exterior gypsum sheathing.
- 3. Division 7 Section "Sheet Metal Flashing and Trim" for field-formed flashings and other sheet metal work not part of metal-faced composite wall panel assemblies.
- 4. Division 7 Section "Joint Sealants."

1.03 REFERENCES

- A. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components.

1.04 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

- 1. Meet with Owner, Architect, Owner's insurer if applicable, metal composite material panel Installer, metal composite material panel manufacturer's representative, structural-support Installer, and installers whose work interfaces with or affects metal composite material panels, including installers of doors, windows, and louvers.

2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
3. Review methods and procedures related to metal composite material panel installation, including manufacturer's written instructions.
4. Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
5. Review flashings, special siding details, wall penetrations, openings, and condition of other construction that affect metal composite material panels.
6. Review governing regulations and requirements for insurance, certificates, and tests and inspections if applicable.
7. Review temporary protection requirements for metal composite material panel assembly during and after installation.
8. Review procedures for repair of panels damaged after installation.
9. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.05 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of metal-faced composite wall panel and accessory.
- B. Shop Drawings: Show fabrication and installation layouts of metal-faced composite wall panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details. Distinguish among factory-, shop-, and field-assembled work.
 1. Indicate the preferred joint details providing a watertight and structurally sound wall panel system that allows no uncontrolled water penetration on the inside face of the panel system as determined by ASTM E 331.
 2. Accessories: Include details of the following items, at a scale of not less than 1-1/2 inches per 12 inches:
 - a. Flashing and trim.
 - b. Anchorage systems.
- C. Delegated-Design Submittal: For metal wall panel assembly indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional structural engineer responsible for their preparation.
- D. Coordination Drawings: Exterior elevations drawn to scale and coordinating penetrations and wall-mounted items. Show the following:
 1. Wall panels and attachments.

2. Wall-mounted items including doors, windows, louvers, and lighting fixtures.
 3. Penetrations of wall by pipes and utilities.
- E. Samples for Initial Selection: For each type of metal-faced composite wall panel indicated with factory-applied color finishes.
1. Include similar Samples of trim and accessories involving color selection.
 2. Include manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each sealant exposed to view.
- F. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:
1. Metal-Faced Composite Wall Panels: Minimum 12 x 12 inches. Include fasteners, closures, and other metal-faced composite wall panel accessories.
 - a. Composite Panels: Include four-way joint.
 2. Trim and Closures: 12 inches long. Include fasteners and other exposed accessories.
 3. Accessories: 12-inch- long Samples for each type of accessory.
 4. Exposed Gaskets: 12 inches long.

1.06 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Compatibility and Adhesion Test Reports: From sealant manufacturer, indicating the following:
 1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
 2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.
- C. Product Test Reports: Based on evaluation of comprehensive tests performed within the last four years by a qualified testing agency, for each product.
- D. Field quality-control reports.
- E. Warranties: Samples of special warranties.

1.07 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For metal composite material panels to include in maintenance manuals.

1.08 QUALITY ASSURANCE

- A. Manufacturer: Metal composite material manufacturer to have a minimum of five years' experience in the manufacture of products specified.
- B. Installer: Installer acceptable to metal composite material manufacturer, with a minimum of five years' experience in the installation of products specified, in scope and size of Project.
 - 1. Panel fabricator / Installer shall assume undivided responsibility for all components of the exterior panel system including, but not limited to attachment to sub-construction, panel to panel joinery, panel to dissimilar material joinery, and joint seal associated with the panel system.
- C. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.
- D. Source Limitations: Obtain each type of metal-faced composite wall panel from single source from single manufacturer.
- E. Material: All metal composite panel material shall be factory trimmed and squared prior to shipment to the fabricator, thereby aiding in quality fabrication processing.
- F. Fire-Test-Response Characteristics: Provide metal wall panels and system components with the following fire-test-response characteristics as determined by testing identical panels and system components per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify products with appropriate markings of applicable testing agency.
 - 1. Fire-Resistance Characteristics: Provide materials and construction tested for fire resistance per ASTM E 119.
 - 2. Intermediate-Scale Multistory Fire Test: Tested mockup, representative of completed multistory wall assembly of which wall panel is a part, complies with NFPA 285 for test method and required fire-test-response characteristics of exterior non-load-bearing wall panel assemblies.
 - 3. Radiant Heat Exposure: No ignition when tested according to NFPA 268.
 - 4. Potential Heat: Acceptable level when tested according to NFPA 259.
 - 5. Surface-Burning Characteristics: Provide wall panels with Class A flame-spread index of 25 or less and smoke-developed index of 450 or less, per ASTM E 84.
- G. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
 - 1. Build mockup of typical wall panel; approximately 10 feet wide by full depth, including supports, attachments, and accessories, in location as directed by Architect.

- a. Include sheathing, air and vapor barrier, and insulation, in each exterior wall mockup.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.09 DELIVERY, STORAGE, AND HANDLING

- A. Deliver components, sheets, metal-faced composite wall panels, and other manufactured items so as not to be damaged or deformed. Package metal-faced composite wall panels for protection during transportation and handling.
- B. Unload, store, and erect metal-faced composite wall panels in a manner to prevent bending, warping, twisting, and surface damage.
- C. Store metal-faced composite wall panels vertically, covered with suitable weathertight and ventilated covering. Store metal-faced composite wall panels to ensure dryness, with positive slope for drainage of water. Do not store metal-faced composite wall panels in contact with other materials that might cause staining, denting, or other surface damage. Do not allow storage space to exceed 120 deg F.
- D. Retain strippable protective covering on metal-faced composite wall panel for period of panel installation.
 1. Wood grained panels must be covered with a protective film to be removed after installation. Protective film to have directional arrows indicating the grain direction. All arrows are to be aligned when installed.

1.10 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal-faced composite wall panels to be performed according to manufacturer's written instructions and warranty requirements.
- B. Field Measurements: Verify locations of structural members and wall opening dimensions by field measurements before metal-faced composite wall panel fabrication and indicate measurements on Shop Drawings.

1.11 COORDINATION

- A. Coordinate metal-faced composite wall panel assemblies with rain drainage work, flashing, trim, and construction of studs, soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.12 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal-faced composite wall panel assemblies that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures, including rupturing, cracking, or puncturing.
 - b. Deterioration of metals and other materials beyond normal weathering.
 - 2. Warranty Period: Ten years from date of Substantial Completion.
- B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal-faced composite wall panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 - 2. Finish Warranty Period: 20 years from date of Substantial Completion.
- C. Special Project Warranty: Submit Installer's warranty, signed by Installer, covering Work of this Section, including all components of metal wall panel system for the following warranty period:
 - 1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. General Performance: Metal-faced composite wall panel assemblies shall comply with performance requirements without failure due to defective manufacture, fabrication, installation, or other defects in construction.
- B. Structural Performance: Provide metal composite material panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E 330:
 - 1. Design Loads: In accordance with the New Hampshire State Building Code and minimum design wind loads for components and cladding indicated on Structural Drawings.
 - 2. Deflection Limits: For wind loads, no greater than 1/175 of the span.
 - 3. Seismic Loads: Provide metal wall panel assemblies capable of withstanding the effects of earthquake motions calculated according to the New Hampshire State Building Code, as determined by the Fabricator's design engineer.
- C. Wind Load: Panels shall be designed to withstand the design loads indicated, but in no case less than 20 psf and 30 psf on parapet and corner panels. Wind load testing shall be conducted in accordance with ASTM E330 to obtain the following results:
 - 1. Normal to the plane of the wall between supports, deflection of the secured perimeter-framing members shall not exceed L/175 or 3/4", whichever is less.
 - 2. Normal to the plane of the wall, the maximum panel deflection shall not exceed L/60 of the full span.
 - 3. Maximum anchor deflection shall not exceed 1/16".
 - 4. At 1-1/2 times design pressure, permanent deflections of framing members shall not exceed L/100 of span length and components shall not experience failure or gross permanent distortion. At connection points of framing members to anchors, permanent set shall not exceed 1/16".
- D. Air Infiltration: Air leakage through assembly of not more than 0.06 cfm/sq. ft. of wall area when tested according to ASTM E 283 at the following test-pressure difference:
 - 1. Test-Pressure Difference: 1.57 lbf/sq. ft.
- E. Water Penetration Under Static Pressure: No water penetration when tested according to ASTM E 331 at the following test-pressure difference:
 - 1. Test-Pressure Difference: 6.24 lbf/sq. ft.

- F. Pressure Equalized Rain Screen System: Comply with AAMA 508-05 Voluntary Test Method and Specification for Pressure Equalized Rain Screen Wall Cladding Systems.
- G. Bond Integrity: No adhesive failure of the bond between the core and skin, or cohesive failure of the core itself when tested in accordance with ASTM D 1781 with the following values.
 - 1. Peel Strength: 115 N mm/mm as manufactured, and after 21 days soaking in water at 70 deg F.
- H. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

2.02 METAL COMPOSITE MATERIAL WALL PANELS

- A. General: Provide factory-formed and -assembled, metal-faced composite wall panels fabricated from two metal facings bonded, using no glues or adhesives, to solid, extruded thermoplastic core; formed into profile for installation method indicated. Include attachment system components and accessories required for weathertight system.
 - 1. Basis of Design Product: Subject to compliance with requirements, provide **Mitsubishi Plastics Composites America, Inc.; Alpolic/fr** or comparable product by one of the following:
 - a. Arconic Architectural Products; Reynobond FR.
 - b. Fairview Architectural; Vitrabond G2.
- B. Aluminum-Faced Composite Wall Panels: Formed with 0.020-inch- thick, coil-coated aluminum sheet facings.
 - 1. Panel Thickness: 4 mm.
 - 2. Core: Fire retardant.
 - 3. Color: As selected by Architect from manufacturer's full range.
- C. Panel Tolerances:
 - 1. Panel Bow: Maximum 0.8% of any 72-inch panel dimension.

2. Panel Dimensions: Field fabrication shall be allowed where necessary, but shall be kept to an absolute minimum. All fabrication shall be done under controlled shop conditions when possible.
 3. Panel lines, breaks, and angles shall be sharp, true, and surfaces free from warp and buckle.
 4. Maximum deviation from panel flatness shall be 1/8" in 5'-0" on panel in any direction for assembled units. (Non-accumulative - No Oil Canning).
- D. Attachment Assembly: Manufacturer's standard rainscreen principle system.
1. System utilizes an extruded horizontal and vertical tongue and groove extrusion system. Reveal joint is open dry joint rain screen principle. Perimeter extrusions reinforce and encapsulate panel returns, eliminating any exposed cut edges and exposed fasteners.
 2. No field sealant required in joints unless specifically noted on drawings.
- E. Attachment System Components: Formed from extruded aluminum.
1. Include manufacturer's standard perimeter extrusions with silicone caulk/sealant, panel stiffeners, panel clips, and anchor channels.

2.03 PANEL MATERIALS

- A. Aluminum Sheet: Coil-coated sheet, ASTM B 209, alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.
1. Surface: Smooth, flat finish.

2.04 MISCELLANEOUS MATERIALS

- A. Aluminum Extrusions: ASTM B 209, alloy and temper recommended by manufacturer for type of use and finish indicated.
- B. Fasteners: Self-tapping screws, bolts, nuts, self-locking rivets and bolts, end-welded studs, and other suitable fasteners designed to withstand design loads. Provide exposed fasteners with heads matching color of metal-faced composite wall panels by means of plastic caps or factory-applied coating. Provide EPDM, PVC, or neoprene sealing washers.

2.05 ACCESSORIES

- A. Wall Panel Accessories: Provide components required for a complete metal-faced composite wall panel assembly including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal-faced composite wall panels unless otherwise indicated.
- B. Flashing and Trim: Formed from 0.030-inch- minimum thickness, aluminum-zinc alloy-coated steel sheet prepainted with coil coating. Provide flashing and trim as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, rakes, fasciae, parapet caps, soffits, reveals, and fillers. Finish flashing and trim with same finish system as adjacent metal-faced composite wall panels.

2.06 FABRICATION

- A. General: Fabricate and finish metal-faced composite wall panels and accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
- B. Fabricate metal-faced composite wall panels in a manner that eliminates condensation on interior side of panel and with joints between panels designed to form weathertight seals.
- C. Metal-Faced Composite Wall Panels: Factory form panels in a continuous process with no glues or adhesives between dissimilar materials. Trim and square edges of sheets with no displacement of face sheets or protrusion of core material.
 - 1. Form panel lines, breaks, and angles to be sharp and true, with surfaces free from warp and buckle.
 - 2. Fabricate panels with sharply cut edges, with no displacement of face sheets or protrusion of core material.
 - 3. Fabricate panels with panel stiffeners, as required to comply with deflection limits, attached to back of panels with structural silicone sealant or bond tape.
 - a. Maximum deviation from panel flatness: 1/8 inch maximum in 60" panel in any direction, non-accumulative.
 - 4. Dimensional Tolerances:
 - a. Panel Bow: 0.8 percent maximum of any 72" panel length or width.
 - b. Squareness: 0.25 inch maximum.

- D. Sheet Metal Accessories: Fabricate flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.
1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
 2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
 3. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
 4. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA standards.
 5. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
 6. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended by metal-faced composite wall panel manufacturer.
 - a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal-faced composite wall panel manufacturer for application, but not less than thickness of metal being secured.

2.07 FINISHES

- A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- C. Aluminum Panels and Accessories:
1. Two-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal-faced composite wall panel supports, and other conditions affecting performance of the Work.
 - 1. Examine wall framing to verify that girts, angles, channels, studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by metal-faced composite wall panel manufacturer.
 - 2. Examine wall sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal-faced composite wall panel manufacturer.
 - 3. Verify that air and vapor barrier has been installed over sheathing or backing substrate to prevent air infiltration or water penetration.
- B. Examine roughing-in for components and systems penetrating metal-faced composite wall panels to verify actual locations of penetrations relative to seam locations of panels before panel installation.
- C. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Miscellaneous Framing: Install subgirts, base angles, sills, furring, and other miscellaneous wall panel support members and anchorage according to ASTM C 754 and metal-faced composite wall panel manufacturer's written instructions.
- B. Retain strippable protective covering on metal-faced composite wall panel for period of panel installation.

3.03 METAL-FACED COMPOSITE WALL PANEL INSTALLATION

- A. General: Install metal-faced composite wall panels according to manufacturer's written instructions in orientation, sizes, and locations indicated on Drawings. Install panels perpendicular to girts and subgirts unless otherwise indicated. Anchor panels and other components of the Work securely in place, with provisions for thermal and structural movement.
 - 1. Erect panels plumb, level, and true.
 - 2. Shim or otherwise plumb substrates receiving metal-faced composite wall panels.

3. Flash and seal metal-faced composite wall panels at perimeter of all openings. Do not begin installation until weather barrier and flashings that will be concealed by panels are installed.
 4. Install flashing and trim as metal-faced composite wall panel work proceeds.
 5. Apply elastomeric sealant continuously between metal base channel (sill angle) and concrete, and elsewhere as indicated or, if not indicated, as necessary for waterproofing.
 6. Provide weathertight escutcheons for pipe and conduit penetrating exterior walls.
- B. Fasteners:
1. Aluminum Wall Panels: Use stainless-steel fasteners for all surfaces.
- C. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action as recommended by metal-faced composite wall panel manufacturer.
- D. Joint Sealers: Install gaskets and joint fillers where indicated and where required for weathertight performance of metal-faced composite wall panel assemblies. Provide types of gaskets, fillers, and sealants indicated or, if not indicated, types recommended by panel manufacturer.
- E. Attachment System Installation, General: Install attachment system required to support metal-faced composite wall panels and to provide a complete weathertight wall system, including subgirts, perimeter extrusions, tracks, drainage channels, panel clips, and anchor channels.
1. Attachment system shall allow for the free and noiseless vertical and horizontal thermal movement due to expansion and contraction for a material temperature range of -20°F to +180°F. Buckling of panels, opening of joints, undue stress on fasteners, failure of sealants or any other detrimental effects due to thermal movement will not be permitted. Fabrication, assembly, and erection procedure shall account for the ambient temperature at the time of the respective operation.
 2. Include attachment to supports, panel-to-panel joinery, panel-to-dissimilar-material joinery, and panel-system joint seals.
 3. Do not begin installation until weather barrier and flashings that will be concealed by composite panels are installed.
- F. Rainscreen-Principle Installation: Install using manufacturer's standard assembly with vertical channel that provides support and secondary drainage assembly, draining at base of wall. Notch vertical channel to receive support pins. Install vertical channels supported by channel brackets or adjuster angles and at locations, spacings, and with fasteners recommended by manufacturer. Attach metal composite material wall panels by inserting horizontal support pins into notches in vertical channels and into flanges of panels. Leave horizontal and vertical joints with open reveal.

1. Install wall panels to allow individual panels to be installed and removed without disturbing adjacent panels.
2. Do not apply sealants to joints unless otherwise indicated.
3. Panels shall be erected in accordance with an approved set of shop drawings.
4. Anchor panels securely per engineering recommendations and in accordance with approved shop drawings to allow for necessary thermal movement and structural support.
5. Conform to panel fabricator's instructions for installation of concealed fasteners.
6. Do not install component parts that are observed to be defective, including warped, bowed, dented, abraded, and broken members.
7. Do not cut, trim, weld, or braze component parts during erection in a manner which would damage the finish, decrease strength, or result in visual imperfection or a failure in performance. Return component parts which require alteration to shop for re-fabrication, if possible, or for replacement with new parts.

3.04 ACCESSORY INSTALLATION

- A. General: Install accessories with positive anchorage to building and weathertight mounting and provide for thermal expansion. Coordinate installation with flashings and other components.
1. Install components required for a complete metal-faced composite wall panel assembly including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
- B. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.
1. Install exposed flashing and trim that is without excessive oil canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof and weather-resistant performance.
 2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

3.05 ERECTION TOLERANCES

- A. Installation Tolerances: Shim and align metal-faced composite wall panel units within installed tolerance of 1/4 inch in 20 feet, nonaccumulative, on level, plumb, and location lines as indicated and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.06 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified independent testing agency to perform field tests and inspections.
- B. Water-Spray Test: After installation, test area of assembly as directed by Commissioning Authority for water penetration according to AAMA 501.2.
- C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect completed metal composite material wall panel installation, including accessories.
- D. Metal composite material wall panels will be considered defective if they do not pass test and inspections.
- E. Additional tests and inspections, at Contractor's expense, are performed to determine compliance of replaced or additional work with specified requirements.
- F. Prepare test and inspection reports.

3.07 CLEANING

- A. Remove temporary protective coverings and strippable films as metal-faced composite wall panels are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of metal-faced composite wall panel installation, clean finished surfaces as recommended by panel manufacturer. Maintain in a clean condition during construction.
- B. After metal-faced composite wall panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.
- C. Replace metal-faced composite wall panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 07427

HIGH PERFORMANCE GFRC WALL PANELS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section includes:

- 1. Glassfiber reinforced concrete panels (slats).
- 2. Aluminum, secondary support system.

- B. Related Sections include the following:

- 1. Division 4 Section "Unit Masonry."
- 2. Division 5 Section "Structural Steel Framing" for steel framing at roof level.
- 3. Division 7 Section "Composite Framing Support System."
- 4. Division 7 Section "Thermal Insulation" for rainscreen insulation.
- 5. Division 7 Section "Water-Resistive Air-Barrier Membranes" for vapor permeable air barrier membrane applied over rainscreen insulation.
- 6. Division 7 Section "Sheet Metal Flashing and Trim" for flashing and other sheet metal work that is not part of metal wall panel assemblies.

1.03 DESIGN REQUIREMENTS

- A. Glass Fiber Concrete Rain Screen: System is a rear ventilated rain screen designed to drain water and condensation to exterior. System is a complete pre-engineered system including Glass Fiber Concrete cladding, aluminum metal support structure, closure pieces, trim and flashing.

- 1. Wall panels shall be removable and fasteners exposed or concealed fastened where indicated.
 - a. Provide 50 percent factory pre-drilled panels.
- 2. Panels are secured to metal support structure over composite framing support system.

3. Aluminum metal support structure has multiple components, with one component attaching to structure over the air barrier using an attachment bracket and one component fastening to bracket horizontally to allow for attachment of panels.
4. Rain screen weather resistive barrier membrane should be visually inspected for breaches and repaired as specified in Division 7 Section “Fluid Applied Membrane Air Barriers” prior to installation of support system.
5. Provide metal drainage flashing to direct condensation and water infiltration within the wall to weeping points. Coordinate with air and vapor barrier specified in Division 7 Section “Fluid Applied Membrane Air Barriers.”

1.04 PERFORMANCE REQUIREMENTS

- A. General Performance: Cementitious wall panel assemblies shall comply with performance requirements without failure due to defective manufacture, fabrication, installation, or other defects in construction.
 1. Failure also includes the following:
 - a. Thermal stresses transferring to building structure.
 - b. Solid exterior wall panels and support structure cracking or breakage.
 - c. Noise or vibration created by wind and thermal and structural movements.
 - d. Loosening or weakening of fasteners, attachments, and other components.
 2. Panel system shall comply with UES-ES Acceptance Criteria for Fiber Cement Siding Evaluation report ER-469.
 3. Comply with ASTM C 1186.
 4. Meet Class A per ASTM E 84.
 5. Panels shall contain no detectable amounts of Crystalline Silica. Panels that do contain Crystalline Silica will be rejected.
 6. System shall accommodate positive drainage for moisture entering or condensation occurring within panel system for 100 year rain cycle.
 7. System shall be flat with no noticeable warpage, buckling, deflections or other surface irregularities.
- B. Delegated Design: Design wall panel assembly and support framing, including comprehensive engineering analysis by a qualified professional structural engineer, licensed in the Commonwealth of Massachusetts using performance requirements and design criteria indicated.
- C. Structural Performance: Provide wall panel assemblies capable of withstanding the effects the following loads and stresses within limits and under conditions indicated, based on testing according to ASTM E 1592:
 1. Design Loads: In accordance with the Massachusetts State Building Code and minimum design wind loads for components and cladding indicated on Drawings.

2. Deflection of Framing Members: At design wind pressure, as follows:
 - a. Deflection Normal to Wall Plane: Limited to edge of panel in a direction perpendicular to panel plane not exceeding $L/240$ of the panel edge length for each panel or an amount that restricts edge deflection of individual panels to manufacturer's product limitations, whichever is less.
 - b. Deflection Parallel to Panel Plane: Limited to $L/360$ of clear span or 1/8 inch, manufacturer's product limitations, whichever is smaller.
 - c. Cantilever Deflection: Where framing members overhang an anchor point, limit deflection to 2 times the length of cantilevered member divided by 175, or manufacturer's product limitations, whichever is smaller.
 3. Maximum Solid Exterior Wall Panels Deflection: $1/360$ of span or less when tested in accordance with positive and negative pressures.
 4. Design exterior cementitious wall panels to accommodate lateral building drift and differential foundation settlement as indicated on Drawings.
 5. Seismic Loads: Provide wall panel assemblies capable of withstanding the effects of earthquake motions calculated according to the Massachusetts State Building Code, as determined by the Fabricator's design engineer.
- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

1.05 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show fabrication and installation layouts of cementitious wall panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details. Distinguish between factory-, shop- and field-assembled work.
 1. Accessories: Include details of the following items, at a scale of not less than 1-1/2 inches per 12 inches:
 - a. Flashing and trim.
 - b. Anchorage systems.

- C. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis and calculations data signed and sealed by the qualified professional structural engineer responsible for their preparation.
- D. Samples for Initial Selection: For GFRC panels.
- E. Samples for Verification: For each type, color, and texture required.
 - 1. 6 inches square, sample of GFRC panel.

1.06 INFORMATION SUBMITTALS

- A. Product Certificates: For GFRC panel signed by product manufacturer.
- B. Test Reports: Submit certified test reports showing compliance with specified performance characteristics and physical properties.
- C. Certificates: Qualification Certificates: Submit certificate indicating compliance with qualification requirements in “Quality Assurance” article.
- D. Product certificates signed by manufacturers certifying materials comply with specified performance characteristics and criteria and physical requirements.
- E. Manufacturers’ Instructions: Manufacturers’ written installation instructions.
- F. Manufacturers’ Field Reports: Manufacturers’ field reports specified herein.
- G. Warranty: Sample of special warranty.

1.07 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data:
 - 1. Operation and maintenance data for installed products.
 - 2. Include methods for maintaining installed products and precautions against cleaning materials and methods detrimental to finishes and performance.

1.08 QUALITY ASSURANCE

- A. Source Limitations for GFRC Panels: Obtain each type, color, texture, and pattern of GFRC panel, including related accessories, through one source from a single manufacturer.

- B. **Manufacturer Qualifications:** Company specializing in production of Glass Fiber Concrete Rain Screens of the type specified with a minimum 10 years documented experience.
- C. **Installer Qualifications:** Company specializing in installation of Glass Fiber Concrete Rain Screen Products of the type specified with a minimum 5 years documented experience.
- D. **Professional Structural Engineer Qualifications:** A professional structural engineer who is legally qualified to practice in the Commonwealth of Massachusetts and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations that are similar to those indicated for this Project in material, design, and extent.
- E. **Mockups:** Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
 - 1. Build mockup of typical wall panel in size and location as directed by Architect; by full wall thickness.
 - a. Include CMU back up, air and vapor barrier, rainscreen anchors, and insulation, in each exterior wall mockup.
 - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 3. Demolish and remove mockups when directed by the Project Manager.
- F. **Preinstallation Conference:** Conduct conference at Project site to comply with requirements in Division 1 Section "Project Meetings."

1.09 DELIVERY, STORAGE, AND HANDLING

- A. Deliver exterior solid GFRC wall panels and support system components packaged to comply with manufacturers' requirements and adequately protected from damage during shipment.
- B. Protect components from adverse job conditions prior to installation.
- C. Protect components from other trades after installation.
- D. Panels are to be stored and handled vertically until installed.
- E. Store exterior solid GFRC wall panels and support system components on platforms or pallets, covered with tarpaulins or other suitable weather-tight ventilated covering. Store components so that water accumulations will drain freely.

- F. Do not store exterior solid GFRC wall panels and support system components in contact with other materials that might cause staining, denting, surface damage or other deleterious effects.

1.10 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with siding installation only if substrate is completely dry and if existing and forecasted weather conditions permit siding to be installed according to manufacturer's written instructions.
- B. Field Measurements: Verify locations of structural members and wall opening dimensions by field measurements before metal wall panel fabrication, and indicate measurements on Shop Drawings.

1.11 SEQUENCING

- A. Coordinate wall panel installation with flashings and other adjoining construction to ensure proper sequencing.

1.12 WARRANTY

- A. Special Warranty for GFRC Panels: Manufacturer's standard form in which manufacturer agrees to repair or replace panels that do not comply with requirements or that fails within specified warranty period. Failures include, but are not limited to, cracking, deforming, or otherwise deteriorating beyond normal weathering.
 - 1. Warranty Period: 10 years from date of Substantial Completion.
- B. Installer Warranty: Written warranty, signed by Installer agreeing to repair or replace materials installed according to manufacturer's written recommendations, that fails in performance, materials, or workmanship within specified warranty period.
 - 1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 HIGH DENSITY GFRC PANELS

- A. GFRC Panels: Glass fiber reinforced concrete, extruded, fiber reinforced concrete panel made from pure mineral raw materials, (sand cement, water) and reinforced with AR (alkali-resistant) glass fibers as woven glass fiber mat and short fibers in the matrix.

1. Basis-of-Design Product: Subject to compliance with requirements, provide **Rieder Smart Elements GmbH; oko skin (distributed by fibreC North America)**, or a comparable product by one of the following:
 - a. GFRC Cladding.
 - b. Stromberg Architectural Products; GFRC Cladding Panels.
2. Panel (Slat) Size: 70.87” x 5.79”.
3. Panel Thickness: 1/2-inch.
4. Panel Edges: Square cut.
5. Panel Weight: 15.6 kg/slat.
6. Surface Texture:
7. Joint Width: 8 mm.
8. Color: Silver Gray.

B. Panel Performance Characteristics:

1. Thermal Expansion: DIN 51045.
2. Surface Burning Characteristics (ASTM E 84):
 - a. Flame Spread – Pass
 - b. Smoke Developed – Pass
 - c. Class A.

2.02 SUPPORT STRUCTURE

- A. Comply with Division 7 Section “Composite Framing Support System” for rainscreen attachment rail system.
- B. Vertical support rails are aluminum U and Z shaped rails attached to L profile to suspend fiber concrete panels. Exposed fasteners attach directly to vertical support rail.
 1. Rail Depth: 1 inch.
- C. Exposed Fasteners: Provide with horizontally oriented exposed fastener attachment system.
 1. Use corrosion resistant fasteners and anchors of type, size, and spacing required for type of substrate and project conditions, to meet performance requirements specified and indicated in design calculations.
- D. Concealed Fasteners: Provide with oko skin hidden fix fastening system using Rieder Power Anchors where indicated.
 1. Starter profiles
 2. Back clips & Top clips

3. Corner connection sheet
4. Rieder Power Anchor & Drill bit
5. Self-drilling screws
6. Bit (1.93“)
7. Side clip instead of top clip for vertical installation
8. Use fastening components required for type of substrate and project conditions to meet performance requirements specified and indicated in design calculations.

2.03 ACCESSORIES

- A. Panel Anchors: Exposed fasteners for attaching GFRC panels to substructure support system. Panel anchor holes to be factory pre-drilled by GFRC panel manufacturer.
 1. Provide manufacturer’s approved fastener with head color matched to panel.
- B. Metal Flashing: Comply with Division 7 Section “Sheet Metal Flashing and Trim.”
- C. Rainscreen Siding Vent: Manufacturer's standard rigid section high-density polypropylene or other UV-stabilized plastic vent; for use at base and head of walls and behind intermediate flashings.
 1. Basis of Design Product: Subject to compliance with requirements, provide **Cor-A-Vent Inc.; SV-3 Siding Vent** or comparable product by the following, or equal:
 - a. DCI Products; CedarVent.
 2. Provide a minimum of 9 square inches of net free area per linear foot.
 3. Profile: 7/16-inch thick by 3-inches high.
 4. Color: Black.
- D. Adhesives: As recommended in GFRC panel manufacturer's written instructions (to be determined per application).
- E. Stainless Steel Drill Screws: Of sufficient lengths and sizes to securely fasten support structure to building wall framing members, and as follows:
 1. Screws complying with ASTM C 1002 for fastening to steel members less than 0.033 inches (0.84 mm) thick.
 2. Screws complying with ASTM C 954 for fastening to steel members from 0.033 to 0.112 inches (0.84 to 2.84 mm) thick.

2.04 FABRICATION

- A. Fabricate wall panels and accessory items in accordance with manufacturers' recommendations and approved submittals.
- B. Panels shall be fabricated to size, with all concealed/undercut anchor holes factory-drilled by the GFRC panel manufacturer.
- C. Field-cut panels and drill face-fastening anchor holes in accordance with the GFRC panel manufacturer's written directions.
- D. Do not field-modify factory-drilled concealed/undercut panel anchor holes.
- E. Fabricate all panels to profiles, colors and textures per samples and approval selected by the Architect.
- F. Fabricate panels in accordance with manufacturers' Quality Management System Tolerances and Acceptance Criteria.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of siding. Proceed with installation only after unsatisfactory conditions have been corrected. Commencement of work indicates acceptance of substrates.
 - 1. Examine wall framing to verify that girts, angles, channels, studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by metal wall panel manufacturer.
 - 2. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.
- B. Examine roughing-in for components and systems penetrating metal wall panels to verify actual locations of penetrations relative to seam locations of metal wall panels before metal wall panel installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Clean substrates of projections and substances detrimental to application.

3.03 INSTALLATION

- A. General: Comply with manufacturer's written installation instructions applicable to products and applications indicated unless more stringent requirements apply.
- B. Install wall reinforcements, channel cleats, clips, hangers, and other accessories required for connecting GFRC wall panels to supporting members and backup materials per project/façade engineers approved design.
 - 1. Start at bottom of wall and fasten panels into vertical aluminum profile at locations of predrilled holes in fiber concrete panels.
 - 2. Layout work to avoid or minimize cuts. Site cut composite wood panels using power saw with appropriate blade type to prevent broken corners, edges and chips.
 - 3. Install panels with continuous vertical and horizontal joints unless otherwise indicated on the Drawings. Vertical and horizontal joints shall be open approximately 5/16 inch (8 mm) wide.
 - 4. Tolerances: Shim and align composite wood panels to form a level or plumb alignment of 1/4 inch in 20 feet maximum, non-accumulative.
- C. Provide miscellaneous reinforcement of adhered panel parts and unitized panel parts per manufacturer and installation contractor's engineer.
- D. Lift GFRC wall panels and install without damage.
- E. Install GFRC panels level, plumb, square, and in alignment.
- F. Provide temporary supports and bracing as required to maintain position, stability, and alignment of panels until permanent connections are completed.
 - 1. Maintain horizontal and vertical joint alignment and uniform joint width.
 - 2. Remove temporary projecting hoisting devices.
- G. Detailing Requirements:
 - 1. Air space at top and bottom of wall termination shall be 1/2- inch to 3/4- inch to facilitate airflow from behind the panels. Do not block vertical airflow at windows, doors, eaves, or at the base of the building. Airflow shall be continuous from bottom to top so there is air movement behind each panel.
 - 2. Fasteners in profile shall accommodate thermal expansion/contraction of metal and not interfere with panel application.
 - 3. Install panels from top of building to bottom.
 - 4. For straight walls, start panel installation in center and work outward.
 - 5. For walls with inside corners, start installation at corner and work across wall.
 - 6. Pattern: As indicated on Drawings. Panel sizes as indicated.

3.04 ADJUSTING AND CLEANING

- A. Remove damaged, improperly installed, or otherwise defective siding materials and replace with new materials complying with specified requirements.
- B. Clean finished surfaces according to siding manufacturer's written instructions and maintain in a clean condition during construction.

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 07543

THERMOPLASTIC POLYOLEFIN (TPO) ROOFING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:

1. FM approved, adhered TPO membrane roofing system.
2. Roof insulation, tapered insulation, and crickets.
3. Air and vapor retarder.
4. High density cover board.
5. Walkway pads.
6. Membrane base flashing.
7. Flashing for roof penetrations.
8. Furnish and install all wood nailers, blocking, and curbs.
9. Curb mounted mechanical equipment to receive base flashing.
10. All hoisting and scaffolding necessary for the completion of the roofing work.
11. Waste disposal.

B. Related Sections:

1. Division 5 Section "Structural Steel" for cast-in-place eye bolt for ladder tie-off, and equipment screen steel framing.
2. Division 5 Section "Pipe and Tube Railings" for steel guardrail at roof edge.
3. Division 6 Section "Miscellaneous Rough Carpentry" for wood blocking furnished and installed by this Section.
4. Division 7 Section "Sheet Metal Flashing and Trim" for metal roof penetration flashings, flashings, counterflashings, and roof edge flashings.
5. Division 7 Section "Joint Sealants."
6. Division 15 Sections for installation of roof drains and related piping.

1.03 DEFINITIONS

- A. TPO: Thermoplastic polyolefin.

- B. Roofing Terminology: See ASTM D 1079 and glossary in NRCA's "The NRCA Roofing and Waterproofing Manual" for definitions of terms related to roofing work in this Section.

1.04 PERFORMANCE REQUIREMENTS

- A. General Performance: Installed membrane roofing and base flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Membrane roofing and base flashings shall remain watertight.
 - 1. Accelerated Weathering: Roofing system shall withstand 2000 hours of exposure when tested according to ASTM G 152, ASTM G 154, or ASTM G 155.
 - 2. Impact Resistance: Roofing system shall resist impact damage when tested according to ASTM D 3746 or ASTM D 4272.
- B. Material Compatibility: Provide roofing materials that are compatible with one another under conditions of service and application required, as demonstrated by membrane roofing manufacturer based on testing and field experience.
- C. Roofing System Design: Provide membrane roofing system that is identical to systems that have been successfully tested by a qualified testing and inspecting agency to resist uplift pressure calculated according to ASCE/SEI 7 and the Massachusetts State Building Code.
 - 1. Exposure Category: Exposure B.
 - 2. Risk Category: IV.
 - 3. Basic Wind Speed: 120 mph.
- D. FM Global Listing: Roofing, base flashings, and component materials shall comply with requirements in FM Global 4450 or FM Global 4470 as part of a built-up roofing system, and shall be listed in FM Global's "RoofNav" for Class 1 or noncombustible construction, as applicable. Identify materials with FM Global markings.
 - 1. Fire / Windstorm Classification: Design and construct roof systems to meet FM uplift criteria for project location.
- E. Exterior Fire-Test Exposure: ASTM E 108 or UL 790, Class A; for application and roof slopes indicated; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1.05 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

- B. Shop Drawings: For roofing system. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Mechanical, electrical, and plumbing coordination drawings.
 - 2. Base flashings and membrane terminations.
 - 3. Tapered insulation, including slopes.
 - 4. Roof plan showing orientation of membrane roofing and fastening spacings and patterns for mechanically fastened membrane roofing.
 - 5. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.
- C. Samples for Verification: For the following products:
 - 1. 6-by-6-inch square of sheet roofing, of color specified, including T-shaped side and end lap seam.
 - 2. 6-by-6-inch square of roof insulation.
 - 3. 6-by-6-inch square of walkway pads or rolls.
 - 4. Six insulation fasteners of each type, length, and finish.
 - 5. Six roof cover fasteners of each type, length, and finish.
- D. Qualification Data: For qualified Installer and manufacturer.
- E. Manufacturer Certificates: Signed by roofing manufacturer certifying that roofing system complies with requirements specified in "Performance Requirements" Article.
 - 1. Submit evidence of compliance with performance requirements.
- F. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for components of membrane roofing system.
- G. FM Form 2688 Contractor's Application for Acceptance of Roof.
- H. Research/Evaluation Reports: For components of membrane roofing system, from the ICC-ES.
- I. Field quality-control reports.
- J. Maintenance Data: For roofing system to include in maintenance manuals.
- K. Warranties: Sample of special warranties.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer that is UL listed for membrane roofing system identical to that used for this Project.

- B. **Installer Qualifications:** A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's warranty.
1. The Installer shall be doing business under the same name for a minimum of 5 years prior to January 1, 2022 and have applied similar roofing systems on 10 or more projects which have been completed for more than two years.
 - a. Furnish names and addresses of each project within 100 miles of Project.
- C. **Installer's Field Supervision:** Maintain a full-time supervisor/foreman on-site during times that the roofing installation is in progress, who is experienced in installing roofing systems similar to type and scope required for this Project, and who is certified by the manufacturer as an approved applicator of the roofing system.
- D. **Source Limitations:** Obtain components including roof insulation and fasteners for membrane roofing system from same manufacturer as membrane roofing.
- E. **Wind Uplift Testing:** Provide uplift testing in accordance with FM Data Sheet 1-52, Field Uplift Tests.
- F. **Preinstallation Conference:** Conduct conference at Project site. Comply with requirements in Division 1 Section "Project Meetings." Review methods and procedures related to roofing system including, but not limited to, the following:
1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, and installers whose work interfaces with or affects roofing including installers of roof accessories and roof-mounted equipment.
 2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
 3. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 4. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.
 5. Review structural loading limitations of roof deck during and after roofing.
 6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect roofing system.
 7. Review governing regulations and requirements for insurance and certificates if applicable.
 8. Review temporary protection requirements for roofing system during and after installation.
 9. Review roof observation and repair procedures after roofing installation.

- G. FM Global Field Evaluation: Notify FM Global at least two weeks prior to the roof installation start date so that FM Global may conduct a field evaluation to review deck securement and confirm materials used.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing and mixing with other components.
- B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.
 - 1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.
- C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.
- D. Handle and store roofing materials and place equipment in a manner to avoid permanent deflection of deck.

1.08 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

1.09 WARRANTY

- A. Special Warranty: Manufacturer's standard or customized form, without monetary limitation, in which manufacturer agrees to repair or replace components of membrane roofing system that fail in materials or workmanship within specified warranty period.
 - 1. Special warranty includes roofing membrane, base flashings, roofing membrane accessories, vapor retarder roof insulation, fasteners, cover boards, walkway products and other components of membrane roofing system.
 - 2. Special warranty includes manufacturer's standard wind speed warranty.
 - 3. Warranty Period: 30 years from date of Substantial Completion.

- B. Special Project Warranty: Submit roofing Installer's warranty, on warranty form at end of this Section, signed by Installer, covering the Work of this Section, including all components of membrane roofing system such as membrane roofing, base flashing, vapor retarder, roof insulation, fasteners, cover boards, and walkway products for the following warranty period:
 - 1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 TPO MEMBRANE ROOFING

- A. Fabric-Reinforced Thermoplastic Polyolefin Sheet: ASTM D 6878, internally fabric or scrim reinforced, uniform, flexible TPO sheet.
 - 1. Product: Subject to compliance with requirements, provide products by one of the following:
 - a. Carlisle SynTec; Sure-Weld.
 - b. Firestone Building Products Company; UltraPly Platinum TPO.
 - c. Johns Manville.
 - 2. Thickness: 80 mils, nominal.
 - 3. Exposed Face Color: White.

2.02 AUXILIARY MEMBRANE ROOFING MATERIALS

- A. General: Auxiliary membrane roofing materials recommended by roofing system manufacturer for intended use, and compatible with membrane roofing.
- B. Sheet Flashing: Manufacturer's standard unreinforced thermoplastic polyolefin sheet flashing, 0.060-inch thick, minimum, of same color as sheet membrane.
- C. Bonding Adhesive: Manufacturer's standard, water based.
- D. Slip Sheet: Manufacturer's standard, of thickness required for application.
- E. Metal Termination Bars: Manufacturer's standard, predrilled stainless-steel or aluminum bars, approximately 1 by 1/8 inch thick; with anchors.
- F. Metal Battens: Manufacturer's standard, aluminum-zinc-alloy-coated or zinc-coated steel sheet, approximately 1 inch wide by 0.05 inch thick, prepunched.

- G. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening membrane to substrate, and acceptable to membrane roofing system manufacturer.
- H. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, lap sealants, termination reglets, and other accessories.

2.03 VAPOR RETARDER

- A. Vapor Retarder Membrane: ASTM D 5147, SBS modified bitumen adhesive, factory laminated to a tri-laminate woven, high-density polyethylene top surface, with a polymeric release liner on the adhesive side.
 - 1. Product: Subject to compliance with requirements, provide one of the following:
 - a. Carlisle; VapAir Seal 725TR.
 - b. Firestone; V-Force Vapor Barrier Membrane.
 - c. Johns Manville; Vapor Barrier SA.
 - 2. Thickness: 40 mils.
 - 3. Moisture Vapor Permeance: ASTM E 96, 0.015 perms.
- B. Primer: Manufacturer's recommended water-based primer for application of vapor barrier membrane on substrate boards.

2.04 ROOF INSULATION

- A. General: Preformed roof insulation boards manufactured or approved by TPO membrane roofing manufacturer, selected from manufacturer's standard sizes suitable for application, of thicknesses indicated.
- B. Polyisocyanurate Board Insulation: ASTM C 1289, Type II, Class 1, Grade 2, felt or glass-fiber mat facer on both major surfaces.
 - 1. To maintain system warranty, manufacturer's approved insulation must be installed.
 - 2. R-Value: 5.7 per inch.
 - 3. Compressive Strength: 20 psi.
- C. Tapered Insulation: Provide factory-tapered insulation boards fabricated to slope of 1/4- inch per 12 inches unless otherwise indicated.
- D. Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated.

2.05 INSULATION ACCESSORIES

- A. General: Furnish roof insulation accessories recommended by insulation manufacturer for intended use and compatibility with membrane roofing.
- B. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roof insulation and cover boards to substrate, and acceptable to roofing system manufacturer.
- C. Bead-Applied Insulation Adhesive: Insulation manufacturer's recommended bead-applied, low-rise, one- or multicomponent urethane adhesive formulated to attach roof insulation to substrate or to another insulation layer.
- D. Full-Spread Applied Insulation Adhesive: Insulation manufacturer's recommended spray-applied, low-rise, two-component urethane adhesive formulated to attach roof insulation to substrate or to another insulation layer.
- E. High Density Cover Board: ASTM C 1289, Type II, Class 2, high density, fiberglass coated, closed-cell polyisocyanurate foam insulation.
 - 1. Compression Strength: ASTM D 1621, not less than 100 psi.
 - 2. Thickness: 1/2-inch or manufacturer's standard not less than 1/4- inch thick.
 - 3. Products: Subject to compliance with requirements, provide one of the following:
 - a. Carlisle SynTec Incorporated; SecurShield HD Plus.
 - b. Firestone Building Products; IsoGuard HD.
 - c. Johns Manville; Invinsa Roof Board.

2.06 WALKWAYS

- A. Flexible Walkways: Factory-formed, nonporous, heavy-duty, slip-resisting, surface-textured walkway pads, approximately 3/16- inch thick, and acceptable to membrane roofing system manufacturer.

2.07 NAILERS, BLOCKING AND PLYWOOD

- A. Comply with requirements for lumber and plywood specified in Division 6 Section "Miscellaneous Rough Carpentry."

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with the following requirements and other conditions affecting performance of roofing system:
1. Verify that roof openings and penetrations are in place and curbs are set and braced.
 2. Verify that wood blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.
 3. Verify that minimum concrete drying period recommended by roofing system manufacturer has passed.
 4. Verify that concrete substrate is visibly dry and free of moisture, and that minimum concrete internal relative humidity is not more than 75 percent, or as recommended by roofing system manufacturer, when tested according to ASTM F 2170.
 - a. Test Frequency: One test probe per each 1000 sq. ft., or portion thereof, of roof deck, with no fewer than three test probes.
 - b. Submit test reports within 24 hours of performing tests.
 5. Verify that concrete-curing compounds that impair adhesion of roofing components to roof deck have been removed.
 6. Proceed with installation only after unsatisfactory conditions have been corrected. Commencement of work indicates acceptance of substrates.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing installation according to roofing system manufacturer's written instructions. Remove sharp projections.
- B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.
- C. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at the end of the workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.

3.03 FASTENER PULL-OUT TESTING

- A. Retain independent testing and inspecting agency to conduct fastener pull-out tests according to SPRI FX-1, and submit test report to Architect and roofing membrane manufacturer before installing new membrane roofing system.
 - 1. Obtain roofing membrane manufacturer's approval to proceed with specified fastening pattern. Roofing membrane manufacturer may furnish revised fastening pattern commensurate with pull-out test results.

3.04 TEMPORARY CUT-OFF

- A. All flashings shall be installed concurrently with the roof membrane in order to maintain a watertight condition as the work progresses. All temporary waterstops shall be constructed to provide a 100 percent watertight seal. The stagger of the insulation joints shall be made even by installing partial panels of insulation. The new membrane shall be carried into the waterstop. Waterstop shall be sealed to the deck or substrate so that water will not be allowed to travel under the new or existing roofing. The edge of the membrane shall be sealed in a continuous heavy application of sealant as specified. When work resumes, the contaminated membrane shall be cut out. All sealant, contaminated membrane, insulation fillers, etc. shall be removed from the work area and properly disposed of offsite. None of these materials shall be used in the new work.
- B. If inclement weather occurs while a temporary waterstop is in place, the Contractor shall provide the labor necessary to monitor the situation to maintain a watertight condition.
- C. If any water is allowed to enter under the newly-completed roofing, the affected area shall be removed and replaced at the Contractor's expense.

3.05 VAPOR-RETARDER INSTALLATION

- A. Substrate must be clean, dry and free of dust, grease or other contaminants; smooth and free of voids. Apply primer to clean and dry surfaces with a brush, roller or sprayer at application rate recommended by manufacturer and as required for substrate. Allow primer to dry completely prior to installation of vapor barrier. Install vapor barrier on the same day as primer.
- B. Laminate Sheet: Install laminate-sheet vapor retarder in a single layer over area to receive vapor retarder, side and end lapping each sheet a minimum of 3 inches and 6 inches, respectively. Stagger end laps a minimum of 12 inches. Bond vapor retarder to substrate as follows:
 - 1. Unroll sheet onto substrate without adhering for alignment. Do not immediately remove the silicone release sheet.

2. Once aligned, peel back a portion of the silicone release sheet and press membrane onto the substrate for initial adherence. Hold sheet tight and peel back release sheet by pulling diagonally.
 3. Use a 75 lb. roller to press sheet down onto the substrate including the laps. Finish by aligning the edge of the roller with the lower end of the side laps and rolling up the membrane. Do not cut membrane to remove air bubbles trapped under laps. Squeeze air bubbles by pushing the roller to the edge of the laps.
- C. Completely seal vapor retarder at terminations, obstructions, and penetrations to prevent air movement into membrane roofing system. Avoid tenting or wrinkles in the vapor retarder. If tenting or wrinkles occur, cut out imperfection and apply patch over area in accordance with manufacturer's instructions.

3.06 WOOD NAILER AND BLOCKING INSTALLATION

- A. Install continuous wood nailers at perimeter of the entire roof, around roof projections, penetrations, and locations indicated.
1. Do not use nailers less than three feet in length.
 2. Build up nailer height to match thickness of substrate or insulation, with smooth transitions.
 - a. Wood blocking and nailers are indicated in nominal lumber sizes. Where required, as indicated or not, provide ripped, continuous shims to create nailer height to match thickness of substrate or insulation.
- B. Anchor nailers to resist a minimum force of 300 lbf in any direction. Provide a 1-1/2" space between lengths of nailers.
1. Anchor nailers with fasteners spaced at 12 inches on center, staggered 1/3 the nailer width and installed within 6 inches of each end.

3.07 INSULATION INSTALLATION

- A. Coordinate installing membrane roofing system components so insulation is not exposed to precipitation or left exposed at the end of the workday.
- B. Comply with membrane roofing system and insulation manufacturer's written instructions for installing roof insulation.
- C. Install tapered insulation under area of roofing to conform to slopes indicated.

- D. Install insulation under area of roofing to achieve required thickness. Where overall insulation thickness is 2.7 inches or greater, install two or more layers with joints of each succeeding layer staggered from joints of previous layer a minimum of 6 inches in each direction.
 - 1. Where installing composite and noncomposite insulation in two or more layers, install noncomposite board insulation for bottom layer and intermediate layers, if applicable, and install composite board insulation for top layer.
- E. Trim surface of insulation where necessary at roof drains so completed surface is flush and does not restrict flow of water.
- F. Install insulation with long joints of insulation in a continuous straight line with end joints staggered between rows, abutting edges and ends between boards. Fill gaps exceeding 1/4 inch with insulation.
 - 1. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.
- G. Adhered Insulation (Non-Nailable Concrete Deck):
 - 1. Adhere insulation to resist uplift pressure at corners, perimeter, and field of roof.
 - 2. Install all layers of insulation, flat and tapered, adhered to substrate with low-rise insulation adhesive in accordance with manufacturer's instructions.
- H. Install cover boards over insulation with long joints in continuous straight lines with end joints staggered between rows. Offset joints of insulation below a minimum of 6 inches in each direction. Loosely butt cover boards together and fasten to roof deck.
 - 1. Adhere cover boards to resist uplift pressure at corners, perimeter, and field of roof.

3.08 ADHERED MEMBRANE ROOFING INSTALLATION

- A. Adhere membrane roofing over area to receive roofing and install according to membrane roofing system manufacturer's written instructions.
- B. Start installation of membrane roofing in presence of membrane roofing system manufacturer's technical personnel.
- C. Accurately align membrane roofing and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.
- D. Bonding Adhesive: Apply to substrate and underside of membrane roofing at rate required by manufacturer and allow to partially dry before installing membrane roofing. Do not apply to splice area of membrane roofing.

- E. In addition to adhering, mechanically fasten membrane roofing securely at terminations, penetrations, and perimeter of roofing.
- F. Apply membrane roofing with side laps shingled with slope of roof deck where possible.
- G. Seams: Clean seam areas, overlap membrane roofing, and hot-air weld side and end laps of membrane roofing and sheet flashings according to manufacturer's written instructions to ensure a watertight seam installation.
 - 1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of sheet membrane.
 - 2. Verify field strength of seams a minimum of twice daily and repair seam sample areas.
 - 3. Repair tears, voids, and lapped seams in roofing that does not comply with requirements.
- H. Spread sealant bed over deck drain flange at roof drains and securely seal membrane roofing in place with clamping ring.
- I. Install membrane roofing and auxiliary materials to tie in to existing roofing to maintain weathertightness of transition and to not void warranty for existing membrane roofing system.

3.09 BASE FLASHING INSTALLATION

- A. Install sheet flashings and preformed flashing accessories and adhere to substrates according to membrane roofing system manufacturer's written instructions.
- B. Apply bonding adhesive to substrate and underside of sheet flashing at required rate and allow to partially dry. Do not apply to seam area of flashing.
- C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.
- D. Clean seam areas, overlap, and firmly roll sheet flashings into the adhesive. Hot-air weld side and end laps to ensure a watertight seam installation.
- E. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

3.10 WALKWAY INSTALLATION

- A. Flexible Walkways: Install walkway products in locations indicated. Adhere walkway products to substrate with compatible adhesive according to roofing system manufacturer's written instructions.

3.11 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified independent testing and inspecting agency to perform roof tests and inspections and to prepare test reports.
 - 1. Infrared thermal scan of completed membrane roofing system.
- B. Uplift Testing: Perform uplift testing in accordance with Data Sheet 1-52, Field Verification of Roof Wind Uplift Resistance.
 - 1. As an alternative to uplift testing, provide visual construction observation of roofing installation as described in Data Sheet 1-52, with prior approval by FM.
- C. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion.
 - 1. Notify Architect or Owner 48 hours in advance of date and time of inspection.
- D. Repair or remove and replace components of membrane roofing system where inspections indicate that they do not comply with specified requirements.
- E. Additional inspections, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.12 PROTECTING AND CLEANING

- A. Protect membrane roofing system from damage and wear during remainder of construction period. When remaining construction will not affect or endanger roofing, inspect roofing for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.
- B. Correct deficiencies in or remove membrane roofing system that does not comply with requirements; repair substrates; and repair or reinstall membrane roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.
- C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.
- D. Clean entire roof at time of Substantial Completion.

3.13 WASTE DISPOSAL

- A. Disposal: At completion of roofing work, transport demolished materials and waste off Owner's property.

1. Separate, salvage, recycle, and dispose of materials in accordance with Commonwealth of Massachusetts "Waste Ban" 310 CMR 19.017.

3.14 PROJECT COMPLETION

- A. Prior to demobilization from the site, the work shall be reviewed by the Owner's Representative and the Applicator. All defects noted and non-compliances with the Specifications or the recommendations of the manufacturer shall be itemized in a punch list. These items must be corrected immediately by the Applicator to the satisfaction of the Owner's Representative and the manufacturer prior to demobilization.
- B. All Warranties referenced in this Section shall have been submitted and have been accepted at time of contract award.

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 07620

SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section Includes:

- 1. Manufactured Products:

- a. Roof edge flashings.

- 2. Formed Products:

- a. Formed counterflashing.
 - b. Formed low-slope roof sheet metal fabrications.
 - c. Roof drainage specialties.
 - d. Roof penetration flashing.
 - e. Metal base flashing.

- 3. All hoisting and scaffolding necessary for the completion of the work.

- 4. Waste disposal.

- B. Related Sections:

- 1. Division 6 Section "Miscellaneous Rough Carpentry" for wood nailers, curbs, blocking, and plywood.
 - 2. Division 7 Section "High Performance GFRC Wall Panels."
 - 3. Division 7 Section "Thermoplastic Polyolefin (TPO) Roofing."
 - 4. Division 8 Section "Aluminum Windows."

1.03 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each manufactured product and accessory.
- B. Shop Drawings: Show fabrication and installation layouts of sheet metal flashing and trim, including plans, elevations, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled work. Include the following:
 - 1. Identification of material, thickness, weight, and finish for each item and location in Project.
 - 2. Details for forming sheet metal flashing and trim, including profiles, shapes, seams, and dimensions.
 - 3. Details for joining, supporting, and securing sheet metal flashing and trim, including layout of fasteners, cleats, clips, and other attachments. Include pattern of seams.
 - 4. Details of termination points and assemblies, including fixed points.
 - 5. Details of expansion joints and expansion-joint covers, including showing direction of expansion and contraction.
 - 6. Details of edge conditions, including eaves, ridges, valleys, rakes, crickets, and counterflashings as applicable.
 - 7. Details of special conditions.
 - 8. Details of connections to adjoining work.
 - 9. Detail formed flashing and trim at a scale of not less than 1-1/2 inches per 12 inches.
- C. Fabrication Samples: For roof edge flashings made from 12-inch lengths of full-size components including fasteners, cover joints, accessories, and attachments.
- D. Samples for Initial Selection: For each type of sheet metal flashing, trim, and accessory indicated with factory-applied color finishes involving color selection.
- E. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:
 - 1. Sheet Metal Flashing: 12 inches long by actual width of unit, including finished seam and in required profile. Include fasteners, cleats, clips, closures, and other attachments.
 - 2. Trim, Metal Closures, Expansion Joints, Joint Intersections, and Miscellaneous Fabrications: 12 inches long and in required profile. Include fasteners and other exposed accessories.
 - 3. Accessories and Miscellaneous Materials: Full-size Sample.
- F. Qualification Data: For qualified fabricator.

- G. Maintenance Data: For sheet metal flashing, trim, and accessories to include in maintenance manuals.
- H. Warranty: Sample of special warranty.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer offering products meeting requirements that are FM Approvals listed for specified class and SPRI ES-1 tested to specified design pressure.
- B. Product Options: Information on Drawings and in Specifications establishes requirements for system's aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including preconstruction testing, field testing, and in-service performance.
 - 1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.
- C. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.
 - 1. For roof edge flashings that are ANSI/SPRI ES-1 tested, shop shall be listed as able to fabricate required details as tested and approved.
- D. Sheet Metal Flashing and Trim Standard: Comply with SMACNA's "Architectural Sheet Metal Manual" unless more stringent requirements are specified or shown on Drawings.
- E. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
 - 1. Build mockup of typical roof edge approximately 10 feet long, including supporting construction, seams, attachments, and accessories.
 - 2. Build mockup of typical gutter and downspout assembly approximately 10 feet long, including supporting construction, seams, attachments, and accessories.
 - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 4. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

- F. Preinstallation Conference: Conduct conference at Project site.
1. Meet with Owner, Architect, Owner's insurer if applicable, Installer, and installers whose work interfaces with or affects sheet metal flashing and trim including installers of roofing materials, roof accessories, unit skylights, and roof-mounted equipment.
 2. Review methods and procedures related to sheet metal flashing and trim.
 3. Examine substrate conditions for compliance with requirements, including flatness and attachment to structural members.
 4. Review special roof details, roof drainage, roof penetrations, and condition of other construction that will affect sheet metal flashing.
 5. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage. Store sheet metal flashing and trim materials away from uncured concrete and masonry.
- B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to the extent necessary for the period of sheet metal flashing and trim installation.

1.06 COORDINATION

- A. Coordinate installation of manufactured roof specialties with interfacing and adjoining construction to provide a leakproof, secure, and noncorrosive installation.

1.07 WARRANTY

- A. Roofing-System Warranty: Roof edge flashings are included in warranty provisions in Division 7 Section "Thermoplastic Polyolefin (TPO) Roofing".
- B. Special Warranty for Roof Edge System: Manufacturer's standard form in which manufacturer agrees to provide a lifetime warranty for the roof edge system, when installed per manufacturer's instructions, covering blow-off from winds up to 105 mph.
 1. Warranty Period: 20 years from date of Substantial Completion, not to exceed life of membrane roofing system.

- C. Special Warranty on Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 - 2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. General: Sheet metal flashing and trim assemblies as indicated shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.
- B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, hole elongation, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Provide clips that resist rotation and avoid shear stress as a result of thermal movements. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.
- C. FM Approvals' Listing: Manufacture and install copings and roof edge fascia that are listed in FM Approvals' "RoofNav" and approved for windstorm classification, Class 1-60-SH. Identify materials with FM Approvals' markings.
- D. SPRI Wind Design Standard: Manufacture and install roof edge flashings tested according to SPRI ES-1.

2.02 SHEET METALS

- A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying a strippable, temporary protective film before shipping.

- B. Aluminum Sheet: ASTM B 209, alloy as standard with manufacturer for finish required, with temper as required to suit forming operations and performance required.
 - 1. Surface: Smooth, flat.
 - 2. Exposed Coil-Coated Finish:
 - a. 2-Coat Fluoropolymer: AAMA 620. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - 3. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.
- C. Zinc-Tin Alloy-Coated Copper Sheet: ASTM B 370, cold-rolled copper sheet, H00 temper, of minimum uncoated weight (thickness) indicated; coated on both sides with a zinc-tin alloy (50 percent zinc, 50 percent tin).
 - 1. Products: Subject to compliance with requirements, provide the following:
 - a. Revere Copper Products, Inc.; FreedomGray.
- D. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 316, dead soft, fully annealed; with smooth, flat surface.
 - 1. Finish: 2D (dull, cold rolled).

2.03 MISCELLANEOUS MATERIALS

- A. General: Provide materials and types of fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and recommended by manufacturer of primary sheet metal or manufactured item unless otherwise indicated.
- B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal or manufactured item.
 - 1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
 - a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating.
 - b. Blind Fasteners: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.

2. Fasteners for Zinc-Tin Alloy-Coated Copper Sheet: Series 300 stainless steel.
3. Fasteners for Aluminum Sheet: Series 300 stainless steel.
4. Fasteners for Stainless-Steel Sheet: Series 300 stainless steel.

C. Solder:

1. For Zinc-Tin Alloy-Coated Copper: ASTM B 32, 100 percent tin.
2. For Stainless Steel: ASTM B 32, Grade Sn60, with acid flux of type recommended by stainless-steel sheet manufacturer.

D. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch (13 mm) wide and 1/8 inch (3 mm) thick.

E. Elastomeric Sealant: ASTM C 920, elastomeric polyurethane polymer sealant; low modulus; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

F. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.

G. Epoxy Seam Sealer: Two-part, noncorrosive, aluminum seam-cementing compound, recommended by aluminum manufacturer for exterior nonmoving joints, including riveted joints.

H. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.04 FABRICATION, GENERAL

A. General: Custom fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, geometry, metal thickness, and other characteristics of item indicated. Fabricate items at the shop to greatest extent possible.

1. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
2. Obtain field measurements for accurate fit before shop fabrication.
3. Form sheet metal flashing and trim without excessive oil canning, buckling, and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.
4. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces exposed to view.

- B. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4 inch in 20 feet on slope and location lines as indicated and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.
- C. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant.
- D. Expansion Provisions: Where lapped expansion provisions cannot be used, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with butyl sealant concealed within joints.
- E. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.
- F. Fabricate cleats and attachment devices of sizes as recommended by SMACNA's "Architectural Sheet Metal Manual" for application, but not less than thickness of metal being secured.
- G. Seams: Fabricate nonmoving seams with flat-lock seams. Tin edges to be seamed, form seams, and solder.
- H. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer.
- I. Do not use graphite pencils to mark metal surfaces.

2.05 ROOF EDGE FLASHINGS

- A. Roof-Edge Fascia: Manufactured, two-piece, roof-edge fascia consisting of snap-on metal fascia cover in section lengths not exceeding 12 feet and a continuous metal receiver with integral drip-edge cleat to engage fascia cover and secure single-ply roof membrane. Provide matching corner units.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide **Metal-Era, Inc.;** **Anchor-Tite Standard Fascia** or comparable product by one of the following:
 - a. Hickman Edge Systems.
 - b. Roofing manufacturer's standard fascia.
 - 2. Formed Aluminum Sheet Fascia Covers: Aluminum sheet, 0.040 inch thick.
 - a. Finish: Two-coat fluoropolymer.
 - a. Color: Weathered Zinc.
 - 3. Corners: Factory mitered and continuously welded.

4. Splice Plates: Concealed, of same material, finish, and shape as fascia cover.
5. Receiver: Extruded aluminum in manufacturer's standard thickness, with pre-punched slotted holes. All bar miters are welded.

2.06 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

- A. Base Flashing: Fabricate from the following material:
 1. Zinc-Tin Alloy-Coated Copper: 20 oz./sq. ft.
- B. Counterflashing: Fabricate from the following material:
 1. Zinc-Tin Alloy-Coated Copper: 20 oz./sq. ft.
- C. Flashing Receivers: Fabricate from the following material:
 1. Zinc-Tin Alloy-Coated Copper: 20 oz./sq. ft.
- D. Equipment Support Flashing: Fabricate from the following material:
 1. Zinc-Tin Alloy-Coated Copper: 20 oz./sq. ft.
- E. Roof-Penetration Flashing: Fabricate from the following material:
 1. Zinc-Tin Alloy-Coated Copper: 20 oz./sq. ft.
- F. Roof-Drain Flashing: Fabricate from the following material:
 1. Zinc-Tin Alloy-Coated Copper: 20 oz./sq. ft.

2.07 ROOF-EDGE DRAINAGE SYSTEMS

- A. Downspouts: Rectangular closed face with mitered elbows, fabricated from aluminum. Furnish wall brackets, from same material and finish as downspouts with anchors.
 1. Wall Brackets: Fabricated from 0.063-inch aluminum, finished to match downspout. Furnish brackets at 60- inch maximum spacing, two brackets minimum per downspout.
 2. Size: As indicated.
 3. Fabricate from the following material:
 - a. Aluminum: 0.050 inch thick.
 - b. Color: Custom, to match Architect's sample.

2.08 WALL SHEET METAL FABRICATIONS

- A. Wall Sheet Metal Base Flashing: Fabricate from the following material:
 - 1. Stainless Steel Sheet: 26 gauge.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions and other conditions affecting performance of the Work.
 - 1. Verify compliance with requirements for installation tolerances of substrates.
 - 2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
- B. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION, GENERAL

- A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
 - 1. Install sheet metal flashing and trim true to line and levels indicated. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.
 - 2. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
 - 3. Space cleats not more than 12 inches apart. Anchor each cleat with two fasteners. Bend tabs over fasteners.
 - 4. Install exposed sheet metal flashing and trim without excessive oil canning, buckling, and tool marks.
 - 5. Install sealant tape where indicated.
 - 6. Torch cutting of sheet metal flashing and trim is not permitted.
 - 7. Do not use graphite pencils to mark metal surfaces.
- B. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by SMACNA.

1. Underlayment: Where installing metal flashing directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slip sheet or install a course of polyethylene sheet.
- C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently watertight, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with sealant concealed within joints.
- D. Fastener Sizes: Use fasteners of sizes that will penetrate wood sheathing not less than 1-1/4 inches for nails and not less than 3/4 inch for wood screws.
- E. Seal joints as shown and as required for watertight construction.
1. Where sealant-filled joints are used, embed hooked flanges of joint members not less than 1 inch into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is moderate, between 40 and 70 deg F, set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40 deg F.
 2. Prepare joints and apply sealants to comply with requirements in Division 7 Section "Joint Sealants."
- F. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pre-tin edges of sheets to be soldered to a width of 1-1/2 inches, except reduce pre-tinning where pre-tinned surface would show in completed Work.
1. Do not solder aluminum sheet.
 2. Pre-tinning is not required for zinc-tin alloy-coated copper.
 3. Do not use torches for soldering. Heat surfaces to receive solder and flow solder into joint. Fill joint completely. Completely remove flux and spatter from exposed surfaces.

3.03 ROOF FLASHING INSTALLATION

- A. General: Install sheet metal flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions,] and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, set units true to line, and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.

- B. Roof Edge Flashing: Anchor to resist uplift and outward forces according to recommendations in SMACNA's "Architectural Sheet Metal Manual" and as indicated. Interlock bottom edge of roof edge flashing with continuous cleat anchored to substrate at staggered 3-inch centers.
- C. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending a minimum of 4 inches over base flashing. Install stainless-steel draw band and tighten.
- D. Counterflashing: Coordinate installation of counterflashing with installation of base flashing. Insert counterflashing in reglets or receivers and fit tightly to base flashing. Extend counterflashing 4 inches over base flashing. Lap counterflashing joints a minimum of 4 inches and bed with sealant. Secure in a waterproof manner by means of snap-in installation and sealant or lead wedges and sealant.
- E. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Seal with elastomeric sealant and clamp flashing to pipes that penetrate roof.

3.04 ROOF-EDGE DRAINAGE-SYSTEM INSTALLATION

- A. General: Install components to produce a complete roof-edge drainage system according to manufacturer's written instructions. Coordinate installation of roof perimeter flashing with installation of roof-edge drainage system.
- B. Downspouts: Join sections with manufacturer's standard telescoping joints. Provide hangers with fasteners designed to hold downspouts securely to walls and 1 inch away from walls; locate fasteners at top and bottom and at approximately 60 inches o.c.
 1. Provide elbows at base of downspouts at grade to direct water away from building.
 2. Connect downspouts to underground drainage system indicated.

3.05 WALL FLASHING INSTALLATION

- A. General: Install sheet metal wall flashing to intercept and exclude penetrating moisture according to SMACNA recommendations and as indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.

3.06 MISCELLANEOUS FLASHING INSTALLATION

- A. Equipment Support Flashing: Coordinate installation of equipment support flashing with installation of roofing and equipment. Weld or seal flashing with elastomeric sealant to equipment support member.

3.07 ERECTION TOLERANCES

- A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 feet on slope and location lines as indicated and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.
- B. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerances specified in MCA's "Guide Specification for Residential Metal Roofing."

3.08 CLEANING AND PROTECTION

- A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
- B. Clean and neutralize flux materials. Clean off excess solder.
- C. Clean off excess sealants.
- D. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of installation, remove unused materials and clean finished surfaces. Maintain in a clean condition during construction.
- E. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

3.09 WASTE DISPOSAL

- A. Unless otherwise indicated, excess materials are Contractor's property. At completion of roofing work, remove from Project site.
 - 1. Separate, salvage, recycle, and dispose of materials in accordance with Commonwealth of Massachusetts "Waste Ban" 310 CMR 19.017.

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 07841

PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section Includes:

- 1. Penetrations in fire-resistance-rated walls, including open penetrations.
- 2. Penetrations in horizontal assemblies.

- B. Related Sections include the following:

- 1. Division 7 Section "Thermal Insulation" for fire safing insulation in non-fire rated horizontal floor/ceiling assemblies.
- 2. Division 15 Sections specifying fire-suppression piping penetrations.
- 3. Division 15 Sections specifying plumbing piping penetrations.
- 4. Division 15 Sections specifying duct and piping penetrations.
- 5. Division 16 Sections specifying cable and conduit penetrations.

1.03 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

- B. Shop Drawings: For each through-penetration firestop system, show each type of construction condition penetrated, relationships to adjoining construction, and type of penetrating item. Include firestop design designation of qualified testing and inspecting agency that evidences compliance with requirements for each condition indicated.

- 1. Submit documentation, including illustrations, from a qualified testing and inspecting agency that is applicable to each through-penetration firestop system configuration for construction and penetrating items.

2. Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular through-penetration firestop condition, submit illustration, with modifications marked, approved by through-penetration firestop system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.
 3. For those firestop applications that exist for which no qualified tested system is available through a manufacturer, an engineering judgment derived from similar qualified tested system designs or other tests is to be submitted to local authorities having jurisdiction for their review and approval prior to installation. Engineering judgment documents must follow requirements set forth by the International Firestop Council.
- C. Through-Penetration Firestop System Schedule: Indicate locations of each through-penetration firestop system, along with the following information:
1. Types of penetrating items.
 2. Types of constructions penetrated, including fire-resistance ratings and, where applicable, thicknesses of construction penetrated.
 3. Through-penetration firestop systems for each location identified by firestop design designation of qualified testing and inspecting agency.

1.05 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Certificates: For through-penetration firestop system products, signed by product manufacturer.
- C. Product Test Reports: From a qualified testing agency indicating through-penetration firestop system complies with requirements, based on comprehensive testing of current products.
- D. Material Safety Data Sheets.

1.06 QUALITY ASSURANCE

- A. Source Limitations: Obtain through-penetration firestop systems, for each kind of penetration and construction condition indicated, through one source from a single manufacturer.
- B. Fire-Test-Response Characteristics: Provide through-penetration firestop systems that comply with the following requirements and those specified in Part 1 "Performance Requirements" Article:
 1. Penetration firestopping tests are performed by a qualified testing agency acceptable to authorities having jurisdiction.

2. Penetration firestopping is identical to those tested per testing standard referenced in "Penetration Firestopping" Article. Provide rated systems complying with the following requirements:
 - a. Penetration firestopping products bear classification marking of qualified testing and inspecting agency.
 - b. Classification markings on penetration firestopping correspond to designations listed by the following:
 - 1) FM Approval in its "Approval Guide."

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver through-penetration firestop system products to Project site in original, unopened containers or packages with intact and legible manufacturers' labels identifying product and manufacturer, date of manufacture, lot number, shelf life if applicable, qualified testing and inspecting agency's classification marking applicable to Project, curing time, and mixing instructions for multicomponent materials.
- B. Store and handle materials for through-penetration firestop systems to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

1.08 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install through-penetration firestop systems when ambient or substrate temperatures are outside limits permitted by through-penetration firestop system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.
- B. Ventilate through-penetration firestop systems per manufacturer's written instructions by natural means or, where this is inadequate, forced-air circulation.
- C. Do not use products and materials that contain flammable solvents.

1.09 COORDINATION

- A. Coordinate construction of openings and penetrating items to ensure that through-penetration firestop systems are installed according to specified requirements.
- B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate through-penetration firestop systems.

- C. Notify Owner's inspecting agency at least seven days in advance of through-penetration firestop system installations; confirm dates and times on days preceding each series of installations.
- D. Do not cover up through-penetration firestop system installations that will become concealed behind other construction until each installation has been examined by Owner's inspecting agency and building inspector, if required by authorities having jurisdiction.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide one of the through-penetration firestop systems indicated for each application in the Through-Penetration Firestop System Schedule at the end of Part 3 that are produced by one of the following manufacturers:
 - 1. Hilti, Inc.
 - 2. 3M; Fire Protection Products Division.
 - 3. Tremco; Tremstop Fire Protection Systems Group.

2.02 PERFORMANCE REQUIREMENTS

- A. General: For penetrations through fire-resistance-rated constructions, including both empty openings and openings containing penetrating items, provide through-penetration firestop systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated.
- B. For through-penetration firestop systems exposed to view, traffic, moisture, and physical damage, provide products that, after curing, do not deteriorate when exposed to these conditions both during and after construction.
 - 1. For piping penetrations for plumbing and wet-pipe sprinkler systems, provide moisture-resistant through-penetration firestop systems.
 - 2. For floor penetrations with annular spaces exceeding 4 inches in width and exposed to possible loading and traffic, provide firestop systems capable of supporting floor loads involved, either by installing floor plates or by other means.
 - 3. For penetrations involving insulated piping, provide through-penetration firestop systems not requiring removal of insulation.

2.03 PENETRATION FIRESTOPPING

- A. Provide penetration firestopping that is produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.
- B. Penetrations in Fire-Resistance-Rated Walls: Provide penetration firestopping with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.
 - 1. Fire-resistance-rated walls include fire walls, fire-barrier walls, smoke-barrier walls, and fire partitions.
 - 2. F-Rating: Not less than the fire-resistance rating of constructions penetrated.
- C. Penetrations in Horizontal Assemblies: Provide penetration firestopping with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.
 - 1. Horizontal assemblies include floors, floor/ceiling assemblies and ceiling membranes of roof/ceiling assemblies.
 - 2. F-Rating: At least 1 hour, but not less than the fire-resistance rating of constructions penetrated.
 - 3. T-Rating: At least 1 hour, but not less than the fire-resistance rating of constructions penetrated except for floor penetrations within the cavity of a wall.
- D. Exposed Penetration Firestopping: Provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.
- E. VOC Content: Provide penetration firestopping that complies with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
 - 1. Architectural Sealants: 250 g/L.
 - 2. Sealant Primers for Nonporous Substrates: 250 g/L.
 - 3. Sealant Primers for Porous Substrates: 775 g/L.
- F. Mold Resistance: Provide penetration firestopping with mold and mildew resistance rating of 0 as determined by ASTM G 21.
- G. Accessories: Provide components for each through-penetration firestop system that are needed to install fill materials and to comply with Part 1 "Performance Requirements" Article. Use only components specified by through-penetration firestop system manufacturer and approved by qualified testing and inspecting agency for firestop systems indicated. Accessories include, but are not limited to, the following items:
 - 1. Permanent forming/damming/backing materials, including the following:

- a. Slag-/rock-wool-fiber insulation.
 - b. Sealants used in combination with other forming/damming/backing materials to prevent leakage of fill materials in liquid state.
 - c. Fire-rated form board.
 - d. Fillers for sealants.
- 2. Temporary forming materials.
 - 3. Substrate primers.
 - 4. Collars.
 - 5. Steel sleeves.

2.04 FILL MATERIALS

- A. General: Provide through-penetration firestop systems containing the types of fill materials required in the Through-Penetration Firestop System Schedule at the end of Part 3 by referencing the types of materials described in this Article. Fill materials are those referred to in directories of referenced testing and inspecting agencies as "fill," "void," or "cavity" materials.
- B. Cast-in-Place Firestop Devices: Factory-assembled devices for use in cast-in-place concrete floors and consisting of an outer metallic or plastic sleeve lined with an intumescent strip, a radial extended flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.
- C. Latex Sealants: Single-component latex formulations that after cure do not re-emulsify during exposure to moisture.
- D. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.
- E. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced elastomeric sheet bonded to galvanized steel sheet.
- F. Intumescent Putties: Nonhardening dielectric, water-resistant putties containing no solvents, inorganic fibers, or silicone compounds.
- G. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.
- H. Pillows/Bags/Blocks: Reusable heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents, and fire-retardant additives.
- I. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

- J. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below:
 - 1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces, and nonsag formulation for openings in vertical and other surfaces requiring a nonslumping, gunnable sealant, unless indicated firestop system limits use to nonsag grade for both opening conditions.
 - 2. Grade for Horizontal Surfaces: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces.
 - 3. Grade for Vertical Surfaces: Nonsag formulation for openings in vertical and other surfaces.

2.05 MIXING

- A. For those products requiring mixing before application, comply with through-penetration firestop system manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of work.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Surface Cleaning: Clean out openings immediately before installing through-penetration firestop systems to comply with firestop system manufacturer's written instructions and with the following requirements:
 - 1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of through-penetration firestop systems.
 - 2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with through-penetration firestop systems. Remove loose particles remaining from cleaning operation.
 - 3. Remove laitance and form-release agents from concrete.

- B. Priming: Prime substrates where recommended in writing by through-penetration firestop system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.
- C. Masking Tape: Use masking tape to prevent through-penetration firestop systems from contacting adjoining surfaces that will remain exposed on completion of Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove smears from firestop system materials. Remove tape as soon as possible without disturbing firestop system's seal with substrates.

3.03 THROUGH-PENETRATION FIRESTOP SYSTEM INSTALLATION

- A. General: Install through-penetration firestop systems to comply with Part 1 "Performance Requirements" Article and with firestop system manufacturer's written installation instructions and published drawings for products and applications indicated.
- B. Install forming/damming/backing materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
 - 1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of firestop systems.
- C. Install fill materials for firestop systems by proven techniques to produce the following results:
 - 1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.
 - 2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
 - 3. For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.04 IDENTIFICATION

- A. Identify through-penetration firestop systems with preprinted plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of edge of the firestop systems, and on both sides of partition, so that labels will be visible to anyone seeking to remove penetrating items or firestop systems. Use self-adhering type with adhesives capable of permanently bonding labels to surfaces on which labels are placed and, in combination with label material, will result in partial destruction of label if removal is attempted. Include the following information on labels:

1. The words "WARNING - PENETRATION FIRESTOPPING SYSTEM - DO NOT DISTURB. NOTIFY BUILDING MANAGEMENT OF ANY DAMAGE."
2. Contractor's name, address, and phone number.
3. Through-penetration firestop system designation of applicable testing and inspecting agency.
4. Date of installation.
5. Through-penetration firestop system manufacturer's name.
6. Installer's name.

3.05 FIELD QUALITY CONTROL

- A. Inspecting Agency: Owner will engage a qualified, independent inspecting agency to inspect through-penetration firestops. Independent inspecting agency shall comply with ASTM E 2174 requirements including those related to qualifications, conducting inspections, and preparing test reports.
 1. Inspection of through-penetration firestopping shall be performed in accordance with ASTM E 2174, "Standard Practice for On-Site Inspection of Installed Fire Stops" or other recognized standard.
- B. Where deficiencies are found, repair or replace through-penetration firestop systems so they comply with requirements.
- C. Proceed with enclosing through-penetration firestop systems with other construction only after inspection reports are issued and firestop installations comply with requirements.

3.06 CLEANING AND PROTECTING

- A. Clean off excess fill materials adjacent to openings as Work progresses by methods and with cleaning materials that are approved in writing by through-penetration firestop system manufacturers and that do not damage materials in which openings occur.
- B. Provide final protection and maintain conditions during and after installation that ensure that through-penetration firestop systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated through-penetration firestop systems immediately and install new materials to produce systems complying with specified requirements.

3.07 THROUGH-PENETRATION FIRESTOP SYSTEM SCHEDULE

- A. Where UL-classified systems are indicated, they refer to alpha-alpha-numeric designations listed in UL's "Fire Resistance Directory" under product Category XHEZ.

- B. Firestop Systems with No Penetrating Items.
 - 1. Available UL-Classified Systems: C-AJ-001-0999.
- C. Firestop Systems for Metallic Pipes, Conduit or Tubing:
 - 1. Available UL-Classified Systems: C-AJ-1001-1999 and W-L-1001-1999.
- D. Firestop Systems for Nonmetallic Pipe, Conduit or Tubing:
 - 1. Available UL-Classified Systems: C-AJ-2001-2999 and W-L-2001-2999.
- E. Firestop Systems for Electrical Cables:
 - 1. Available UL-Classified Systems: C-AJ-3001-3999 and W-L-3001-3999.
- F. Firestop Systems for Cable Trays:
 - 1. Available UL-Classified Systems: C-AJ-4001-4999 and W-L-3001-3999.
- G. Firestop Systems for Insulated Pipes:
 - 1. Available UL-Classified Systems: C-AJ-5001-5999 and W-L-5001-5999.
- H. Firestop Systems for Miscellaneous Electrical Penetrants (Busducts):
 - 1. Available UL-Classified Systems: C-AJ-6001-6999 and W-L-6001-6999.
- I. Firestop Systems for Miscellaneous Mechanical Penetrants (Ductwork):
 - 1. Available UL-Classified Systems: C-AJ-7001-7999 and W-L-7001-7999.
- J. Firestop Systems for Groupings of Penetrants:
 - 1. Available UL-Classified Systems: C-AJ-8001-8999 and W-L-8001-8999.

END OF SECTION

SECTION 07920

JOINT SEALANTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section Includes:

- 1. Silicone joint sealants.
- 2. Urethane joint sealants.

- B. Related Sections include the following:

- 1. Division 4 Section "Unit Masonry" for masonry control and expansion joint fillers and gaskets.
- 2. Division 7 Section "Thermoplastic Polyolefin (TPO) Roofing" for lapping vapor retarders and air barriers.
- 3. Division 7 Section "Penetration Firestopping" for sealing through penetrations in fire-resistance rated construction.
- 4. Division 8 Section "Aluminum Windows."
- 5. Division 8 Section "Glazing" for glazing sealants.

1.03 PRECONSTRUCTION TESTING

- A. Preconstruction Compatibility and Adhesion Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.

- 1. Use ASTM C 1087 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
- 2. Submit not fewer than eight pieces of each type of material, including joint substrates, shims, joint-sealant backings, secondary seals, and miscellaneous materials.
- 3. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
- 4. For materials failing tests, obtain joint-sealant manufacturer's written instructions for corrective measures including use of specially formulated primers.

5. Testing will not be required if joint-sealant manufacturers submit joint preparation data that are based on previous testing of current sealant products for adhesion to, and compatibility with, joint substrates and other materials matching those submitted.

1.04 PERFORMANCE REQUIREMENTS

- A. Provide elastomeric joint sealants that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.
- B. Provide joint sealants for interior applications that establish and maintain airtight and water-resistant continuous joint seals without staining or deteriorating joint substrates.

1.05 ACTION SUBMITTALS

- A. Product Data: For each joint-sealant product indicated.
- B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.
- C. Samples for Verification: For each type and color of joint sealant required, provide Samples with joint sealants in 1/2-inch- wide joints formed between two 6-inch- long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.
- D. Joint-Sealant Schedule: Include the following information:
 1. Joint-sealant application, joint location, and designation.
 2. Joint-sealant manufacturer and product name.
 3. Joint-sealant formulation.
 4. Joint-sealant color.

1.06 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of joint sealant and accessory, signed by product manufacturer.
- B. Qualification Data: For Installer.
- C. Compatibility and Adhesion Test Reports: From sealant manufacturer, indicating the following:
 1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
 2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.

- D. Product Test Reports: Based on comprehensive testing of product formulations performed by a qualified testing agency, indicating that sealants comply with requirements.
- E. Preconstruction Compatibility and Adhesion Test Reports: From sealant manufacturer, indicating the following:
 - 1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
 - 2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.
- F. Warranties: Special warranties specified in this Section.

1.07 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized Installer who is approved or licensed for installation of elastomeric sealants required for this Project.
- B. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.
- C. Product Testing: Test joint sealants using a qualified testing agency.
 - 1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.
 - 2. Test according to SWRI's Sealant Validation Program for compliance with requirements specified by reference to ASTM C 920 for adhesion and cohesion under cyclic movement, adhesion-in-peel, and indentation hardness.
- D. Mockups: Build mockups incorporating sealant joints, as follows, to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution:
 - 1. Joints in mockups of assemblies specified in other Sections that are indicated to receive elastomeric joint sealants, which are specified by reference to this Section.
 - 2. Each type of sealant and joint substrate indicated.
- E. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

1.08 PROJECT CONDITIONS

- A. Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F.
2. When joint substrates are wet.
3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
4. Contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.09 WARRANTY

- A. Special Installer's Warranty: Installer's standard form in which Installer agrees to repair or replace elastomeric joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 1. Warranty Period: Two years from date of Substantial Completion.
- B. Special Manufacturer's Warranty: Manufacturer's standard form in which elastomeric sealant manufacturer agrees to furnish elastomeric joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.
 1. Warranty Period for Urethane: Five years from date of Substantial Completion.
 2. Warranty Period for Silicone: 20 years from date of Substantial Completion.
- C. Special warranties specified in this Article exclude deterioration or failure of elastomeric joint sealants from the following:
 1. Movement of the structure resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression caused by structural settlement or errors attributable to design or construction.
 2. Disintegration of joint substrates from natural causes exceeding design specifications.
 3. Mechanical damage caused by individuals, tools, or other outside agents.
 4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.01 MATERIALS, GENERAL

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.

- B. VOC Content of Interior Sealants: Provide sealants and sealant primers for use inside the weatherproofing system that comply with the following limits for VOC content when calculated according to 40 CFR 59, Part 59, Subpart D (EPA Method 24):
 - 1. Architectural Sealants: 250 g/L.
 - 2. Sealant Primers for Nonporous Substrates: 250 g/L.
 - 3. Sealant Primers for Porous Substrates: 775 g/L.
- C. Stain-Test-Response Characteristics: Where sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.
- D. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.02 SILICONE JOINT SEALANTS

- A. Single-Component, Nonsag, Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 100/50, for Use NT.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dow Corning Corporation; 790.
 - b. Pecora Corporation; 890 NST.
 - c. Tremco Incorporated; Spectrem 1.
- B. Mildew Resistant, Single-Component, Nonsag, Acid-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 25, for Use NT.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dow Corning Corporation; 786 Mildew Resistant.
 - b. GE Silicones; Sanitary SCS1700.
 - c. Tremco; Tremsil 200 Sanitary.

2.03 URETHANE JOINT SEALANTS

- A. Single-Component, Nonsag, Urethane Joint Sealant: ASTM C 920, Type S, Grade NS, Class 25, for Use NT.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. BASF Corporation-Construction Systems; MasterSeal NP 1.
 - b. Pecora Corporation; Dynatrol I-XL.
 - c. Sherwin Williams; Loxon 1K Smooth.
 - d. Sika Corporation, Construction Products Division; Sikaflex - 1a.

- e. Tremco; Dymonic.
- B. Multicomponent, Nonsag, Urethane Joint Sealant: ASTM C 920, Type M, Grade NS, Class 50, for Use NT.
- 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. BASF Corporation-Construction Systems; MasterSeal NP 2.
 - b. Pecora Corporation; Dynatrol II.
 - c. Tremco; Dymeric 240 FC.
- C. Multicomponent, Pourable, Traffic-Grade, Urethane Joint Sealant: ASTM C 920, Type M, Grade P, Class 25, for Use T and I.
- 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. BASF Corporation-Construction Systems; MasterSeal SL 2.
 - b. Pecora Corporation; Dynatrol II-SG.
 - c. Tremco; THC-900.

2.04 JOINT-SEALANT BACKING

- A. General: Provide sealant backings of material and type that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin) as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
- C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

2.05 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
 - 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
 - 2. Clean porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
 - a. Concrete.
 - b. Masonry.
 - c. Unglazed surfaces of ceramic tile.
 - 3. Remove laitance and form-release agents from concrete.
 - 4. Clean nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:
 - a. Metal.

- b. Glass.
 - c. Porcelain enamel.
 - d. Glazed surfaces of ceramic tile.
- B. **Joint Priming:** Prime joint substrates, where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. **Masking Tape:** Use masking tape where required to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.03 INSTALLATION OF JOINT SEALANTS

- A. **General:** Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. **Sealant Installation Standard:** Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. **Install sealant backings of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.**
- 1. Do not leave gaps between ends of sealant backings.
 - 2. Do not stretch, twist, puncture, or tear sealant backings.
 - 3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.
- D. **Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.**
- E. **Install sealants using proven techniques that comply with the following and at the same time backings are installed:**
- 1. Place sealants so they directly contact and fully wet joint substrates.
 - 2. Completely fill recesses in each joint configuration.
 - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- F. **Tooling of Nonsag Sealants:** Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

1. Remove excess sealant from surfaces adjacent to joints.
2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
3. Provide concave joint configuration per Figure 5A in ASTM C 1193, unless otherwise indicated.

3.04 CLEANING

- A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.05 PROTECTION

- A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.06 JOINT-SEALANT SCHEDULE

- A. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal nontraffic surfaces.
 1. Joint Locations:
 - a. Control and expansion joints in ceilings and other overhead surfaces.
 - b. Joints between aluminum windows and other materials.
 - c. Other joints as indicated.
 2. Silicone Joint Sealant: Single component, nonsag, neutral curing, Class 100/50.
 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors, for each material.
- B. Joint-Sealant Application: Interior joints in horizontal traffic surfaces.
 1. Joint Locations:
 - a. Isolation joints in cast-in-place concrete slabs.
 - b. Other joints as indicated.
 2. Urethane Joint Sealant: Multicomponent, pourable, traffic grade, Class 25.
 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range.

- C. Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces.
1. Joint Sealant Location:
 - a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
 - b. Other joints as indicated.
 2. Joint Sealant: Single component, nonsag, mildew resistant, acid curing silicone.
 3. Joint-Sealant Color: White.

END OF SECTION

DIVISION 08

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 08110

HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section includes hollow-metal work.
- B. Related Requirements:
 - 1. Division 4 Section "Unit Masonry" for building anchors into and grouting hollow metal frames in masonry construction.
 - 2. Division 8 Section "Door Hardware."
 - 3. Division 9 Section "Painting" for field painting hollow metal doors and frames.
 - 4. Division 16 Sections for electrical connections including conduit and wiring for door controls.

1.03 DEFINITIONS

- A. Minimum Thickness: Minimum thickness of base metal without coatings according to NAAMM-HMMA 803 or SDI A250.8.

1.04 COORDINATION

- A. Coordinate anchorage installation for hollow-metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

1.05 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Meet with Architect, electrical contractor, security systems supplier, and hardware installers whose work interfaces with or affects hollow metal doors and frames.

2. Review requirements for type of cut-out and back-box as part of the door and frame assembly.
3. Document proceedings, including receipt of samples and approved shop drawings of security contact devices which accurately represent the installation of the device, back-box, and conduit terminations required.
4. Distribute an installation book, including all manuals and instructions.

1.06 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 1. Include construction details, material descriptions, core descriptions, fire-resistance ratings, and finishes.
- B. Shop Drawings: Include the following:
 1. Elevations of each door type.
 2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
 3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
 4. Locations of reinforcement and preparations for hardware.
 5. Details of each different wall opening condition.
 6. Details of anchorages, joints, field splices, and connections.
 7. Details of accessories.
 8. Details of moldings, removable stops, and glazing.
 9. Details of conduit and preparations for power, signal, and control systems.
- C. Schedule: Provide a schedule of hollow-metal work prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final Door Hardware Schedule.

1.07 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each type of hollow-metal door and frame assembly, for tests performed by a qualified testing agency.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Deliver hollow-metal work palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.
 1. Provide additional protection to prevent damage to factory-finished units.

- B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
- C. Store hollow-metal work vertically under cover at Project site with head up. Place on minimum 4-inch-high wood blocking. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Ceco Door; ASSA ABLOY.
 - 2. Curries Company; ASSA ABLOY.
 - 3. DE LA FONTAINE.
 - 4. Steelcraft; an Allegion brand.
- B. Source Limitations: Obtain hollow-metal work from single source from single manufacturer.

2.02 REGULATORY REQUIREMENTS

- A. Fire-Rated Assemblies: Complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.

2.03 EXTERIOR HOLLOW-METAL DOORS AND FRAMES

- A. Construct exterior doors and frames to comply with the standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Extra-Heavy-Duty Doors and Frames: SDI A250.8, Level 3.
 - 1. Physical Performance: Level A according to SDI A250.4.
 - 2. Doors:
 - a. Type: As indicated in the Door and Frame Schedule.
 - b. Thickness: 1-3/4 inches
 - c. Face: Metallic-coated steel sheet, minimum thickness of 0.053 inch (16 gauge), with minimum A60 coating.
 - d. Edge Construction: Model 2, Seamless.
 - e. Core: Polyurethane.

- 1) Thermal-Rated Doors: Provide doors fabricated with an average U-factor of not more than **0.37** Btu/sq. ft. x h x deg F (R-value of 2.7 minimum) when tested according to ASTM C 1363 for operable door assembly.
3. Frames: Provide maximum-duty frames for exterior frames.
 - a. Materials: Metallic-coated steel sheet, minimum thickness of 0.067 inch (14 gauge), with minimum A60 coating.
 - b. Construction: Face welded.
4. Exposed Finish: Prime.

2.04 FRAME ANCHORS

A. Jamb Anchors:

1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.042 inch thick, with corrugated or perforated straps not less than 2 inches wide by 10 inches long; or wire anchors not less than 0.177 inch thick.

B. Floor Anchors: Formed from same material as frames, minimum thickness of 0.042 inch, and as follows:

1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.

2.05 MATERIALS

A. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B, with minimum A60 metallic coating.

B. Frame Anchors: ASTM A 879/A 879M, Commercial Steel (CS), 04Z coating designation; mill phosphatized.

1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.

C. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.

D. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.

- E. Grout: ASTM C 476, except with a maximum slump of 4 inches, as measured according to ASTM C 143/C 143M. Comply with Division 4 Section “Unit Masonry.”
- F. Bituminous Coating: Cold-applied asphalt mastic, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.06 FABRICATION

- A. Fabricate hollow-metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for metal thickness. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.
- B. Hollow-Metal Doors:
 - 1. Steel-Stiffened Door Cores: Provide minimum thickness 0.026 inch, steel vertical stiffeners of same material as face sheets extending full-door height, with vertical webs spaced not more than 6 inches apart. Spot weld to face sheets no more than 5 inches o.c. Fill spaces between stiffeners with glass- or mineral-fiber insulation.
 - 2. Fire Door Cores: As required to provide fire-protection and temperature-rise ratings indicated.
 - 3. Vertical Edges for Single-Acting Doors: Bevel edges 1/8 inch in 2 inches.
 - 4. Top Edge Closures: Close top edges of doors with inverted closures, except provide flush closures at exterior doors of same material as face sheets.
 - 5. Bottom Edge Closures: Close bottom edges of doors where required for attachment of weather stripping with end closures or channels of same material as face sheets.
 - 6. Exterior Doors: Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.
 - 7. Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch beyond edge of door on which astragal is mounted or as required to comply with published listing of qualified testing agency.
- C. Hollow-Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
 - 1. Sidelite Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
 - 2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.

3. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.
 4. Floor Anchors: Weld anchors to bottoms of jambs with at least four spot welds per anchor; however, for slip-on drywall frames, provide anchor clips or countersunk holes at bottoms of jambs.
 5. Jamb Anchors: Provide number and spacing of anchors as follows:
 - a. Masonry Type: Locate anchors not more than 16 inches from top and bottom of frame. Space anchors not more than 32 inches o.c., to match coursing, and as follows:
 - 1) Two anchors per jamb up to 60 inches high.
 - 2) Three anchors per jamb from 60 to 90 inches high.
 - 3) Four anchors per jamb from 90 to 120 inches high.
 - 4) Four anchors per jamb plus one additional anchor per jamb for each 24 inches or fraction thereof above 120 inches high.
 6. Head Anchors: Two anchors per head for frames more than 42 inches wide and mounted in metal-stud partitions.
 7. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.
 - a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
 - b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.
- D. Fabricate concealed stiffeners and edge channels from either cold- or hot-rolled steel sheet.
- E. Hardware Preparation: Factory prepare hollow-metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule, and templates.
1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
 2. Comply with applicable requirements in SDI A250.6 and BHMA A156.115 for preparation of hollow-metal work for hardware.
 3. Coordinate locations of conduit and wiring boxes for electrical connections with Division 16 Sections.
- F. Hardware Reinforcement: Fabricate reinforcement plates from same material as frames to comply with manufacturer's standard gauges and sizes, but not less than the following minimum sizes.
1. Hinges: Minimum 10 gauge by 1-1/2 inches wide by 6 inches longer than hinge, secured by not less than 6 spot welds.
 2. Lock Face, Flush and Surface Bolts, Closers, and Concealed Holders: Minimum 14 gauge.

3. Pull Plates and Bar: Minimum 16 gauge.

2.07 STEEL FINISHES

- A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.
 1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

2.08 ACCESSORIES

- A. Grout Guards: Formed from same material as frames, not less than 0.016 inch thick.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.
- B. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.03 INSTALLATION

- A. General: Install hollow-metal work plumb, rigid, properly aligned, and securely fastened in place. Comply with Drawings and manufacturer's written instructions.

- B. Hollow-Metal Frames: Install hollow-metal frames for doors, transoms, sidelites, borrowed lites, and other openings, of size and profile indicated. Comply with SDI A250.11 or NAAMM-HMMA 840 as required by standards specified.
1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
 - a. At fire-rated openings, install frames according to NFPA 80.
 - b. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
 - c. Install frames with removable stops located on secure side of opening.
 - d. Install door silencers in frames before grouting.
 - e. Remove temporary braces necessary for installation only after frames have been properly set and secured.
 - f. Check plumb, square, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
 - g. Field apply bituminous coating to backs of frames that will be filled with grout containing antifreezing agents.
 2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.
 - a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
 3. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout.
 4. Installation Tolerances: Adjust hollow-metal door frames for squareness, alignment, twist, and plumb to the following tolerances:
 - a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
 - c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.
- C. Hollow-Metal Doors: Fit hollow-metal doors accurately in frames, within clearances specified below. Shim as necessary.
1. Non-Fire-Rated Steel Doors:

- a. Between Door and Frame Jambs and Head: 1/8 inch plus or minus 1/32 inch.
 - b. Between Edges of Pairs of Doors: 1/8 inch to 1/4 inch plus or minus 1/32 inch.
 - c. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch.
 - d. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 inch.
 - e. Between Door Face and Stop: 1/16 inch to 1/8 inch plus or minus 1/32 inch.
2. Fire-Rated Doors: Install doors with clearances according to NFPA 80, and the following:
- a. Jambs and Head: 1/8 inch plus or minus 1/16 inch.
 - b. Between Edges of Pairs of Doors: 1/8 inch plus or minus 1/16 inch.
 - c. Between Bottom of Door and Top of noncombustible Threshold: Maximum 3/8 inch.
 - d. Between Bottom of Door and Top of noncombustible Finish Floor (No Threshold): Maximum 3/4 inch.
 - e. Between Bottom of Door and all other Finish Floor Coverings: Maximum 1/2 inch.

3.04 ADJUSTING AND CLEANING

- A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow-metal work that is warped, bowed, or otherwise unacceptable.
- B. Remove grout and other bonding material from hollow-metal work immediately after installation.
- C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.
- D. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in Division 9 Section "Painting."

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 08520
ALUMINUM WINDOWS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section includes:
 - 1. Fixed and operable aluminum-framed windows for exterior locations.
- B. Related Sections:
 - 1. Division 6 Section "Miscellaneous Rough Carpentry" for wood blocking.
 - 2. Division 7 Section "Joint Sealants."
 - 3. Division 8 Section "Glazing" for glazing requirements for aluminum windows.

1.03 DEFINITIONS

- A. Performance class designations according to AAMA/WDMA 101/I.S.2/NAFS:
 - 1. AW: Architectural.
- B. Performance grade number according to AAMA/WDMA 101/I.S.2/NAFS:
 - 1. Design pressure number in pounds force per square foot used to determine the structural test pressure and water test pressure.
- C. Structural Test Pressure: For uniform load structural test, is equivalent to 150 percent of the design pressure.
- D. Minimum Test Size: Smallest size permitted for performance class (gateway test size). Products must be tested at minimum test size or at a size larger than minimum test size to comply with requirements for performance class.

1.04 PERFORMANCE REQUIREMENTS

- A. General: Provide aluminum windows capable of complying with performance requirements indicated, based on testing manufacturer's windows that are representative of those specified, and that are of minimum test size indicated below:
 - 1. Size required by AAMA/WDMA 101/I.S.2/NAFS for gateway performance, not less than 4'-0" x 6'-0".
- B. Delegated Design: Design aluminum-framed systems, including comprehensive engineering analysis by a qualified professional engineer licensed in the Commonwealth of Massachusetts, using performance requirements and design criteria indicated.
- C. Structural Performance: Provide aluminum windows capable of withstanding the effects of the following loads, based on testing units representative of those indicated for Project that pass AAMA/WDMA 101/I.S.2/NAFS, Uniform Load Structural Test:
 - 1. Design Wind Loads: Determine design wind loads applicable to Project from basic wind speed indicated in miles per hour at 33 feet above grade, according to ASCE 7, Section 6.5, "Method 2-Analytical Procedure," based on mean roof heights above grade indicated on Drawings.
 - a. Risk Category: IV.
 - b. Basic Wind Speed: 120 mph.
 - c. Exposure Category: B.
 - 2. Deflection: Design glass framing system to limit lateral deflections of glass edges to less than 1/175 of glass-edge length or 3/4 inch, whichever is less, at design pressure based on testing performed according to AAMA/WDMA 101/I.S.2/NAFS, Uniform Load Deflection Test or structural computations.
- D. Thermal Movements: Provide aluminum windows, including anchorage, that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change (Range): 120 deg F, ambient; 180 deg F material surfaces.

1.05 SUBMITTALS

- A. Product Data: Include construction details, material descriptions, fabrication methods, dimensions of individual components and profiles, hardware, finishes, and operating instructions for each type of aluminum window indicated.

- B. Shop Drawings: Include plans, elevations, sections, details, hardware, attachments to other work, operational clearances, installation details, and the following:
1. Mullion details, including reinforcement and stiffeners.
 2. Joinery details.
 3. Expansion provisions.
 4. Flashing and drainage details.
 5. Weather-stripping details.
 6. Thermal-break details.
 7. Glazing details.
 8. Window cleaning provisions.
 9. For installed products indicated to comply with design loads, include structural analysis data prepared by or under the supervision of a qualified professional engineer licensed in the Commonwealth of Massachusetts detailing fabrication and assembly of aluminum windows and used to determine the following:
 - a. Structural test pressures and design pressures from wind loads indicated, and the Massachusetts State Building Code.
 - b. Deflection limitations of glass framing systems.
- C. Samples for Initial Selection: For units with factory-applied color finishes.
1. Include similar Samples of hardware and accessories involving color selection.
- D. Samples for Verification: For aluminum windows and components required, prepared on Samples of size indicated below.
1. Main Framing Member: 12-inch- long, full-size sections of extrusions with factory-applied color finish.
 2. Hardware: Full-size units with factory-applied finishes.
 3. Weather Stripping: 12-inch- long sections.
- E. Product Schedule: For aluminum windows. Use same designations indicated on Drawings.
- F. Qualification Data: For Installer, professional engineer and testing agency.
- G. Field quality-control test reports.
- H. Product Test Reports: Based on evaluation of comprehensive tests performed within the last four years by a qualified testing agency for each type, class, grade, and size of aluminum window. Test results based on use of downsized test units will not be accepted.
- I. Maintenance Data: For operable window sash, operating hardware, weather stripping, and finishes to include in maintenance manuals.
- J. Warranty: Special warranty specified in this Section.

1.06 QUALITY ASSURANCE

- A. **Installer Qualifications:** An installer acceptable to aluminum window manufacturer for installation of units required for this Project.
 - 1. Installer's responsibilities include providing professional engineering services needed to assume engineering responsibility.
 - 2. **Engineering Responsibility:** Preparation of data for aluminum windows, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.
- B. **Manufacturer Qualifications:** A manufacturer capable of fabricating aluminum windows that meet or exceed performance requirements indicated and of documenting this performance by inclusion in lists and by labels, test reports, and calculations.
- C. **Product Options:** Drawings indicate size, profiles, and dimensional requirements of aluminum windows and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements." Do not modify size and dimensional requirements.
 - 1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.
- D. **Fenestration Standard:** Comply with AAMA/WDMA 101/I.S.2/NAFS, "North American Fenestration Standard Voluntary Performance Specification for Windows, Skylights and Glass Doors," for definitions and minimum standards of performance, materials, components, accessories, and fabrication. Comply with more stringent requirements if indicated.
- E. **Glazing Publications:** Comply with published recommendations of glass manufacturers and with GANA's "Glazing Manual" unless more stringent requirements are indicated.
- F. **Preinstallation Conference:** Conduct conference at Project site to comply with requirements in Division 1 Section "Project Meetings." Review methods and procedures related to aluminum windows including, but not limited to, the following:
 - 1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - 2. Review and discuss the finishing of aluminum windows that is required to be coordinated with the finishing of other aluminum work for color and finish matching.
 - 3. Review, discuss, and coordinate the interrelationship of aluminum windows with other exterior wall components. Include provisions for structural anchorage, glazing, flashing, weeping, sealants, and protection of finishes.
 - 4. Review and discuss the sequence of work required to construct a watertight and weathertight exterior building envelope.

5. Inspect and discuss the condition of substrate and other preparatory work performed by other trades.

1.07 PROJECT CONDITIONS

- A. Field Measurements: Verify aluminum window openings by field measurements before fabrication and indicate measurements on Shop Drawings.

1.08 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace aluminum windows that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

- a. Failure to meet performance requirements.
- b. Structural failures including excessive deflection, water leakage, air infiltration, or condensation.
- c. Faulty operation of movable sash and hardware.
- d. Deterioration of metals, other materials, and metal finishes beyond normal weathering.
- e. Failure of insulating glass.

2. Warranty Period: 10 years from date of Substantial Completion.

- B. Special Project Warranty: Submit Installer's warranty, signed by Installer, covering Work of this Section, including all installation components of aluminum window system for the following warranty period:

1. Warranty Period: Two years from date of Substantial Completion.

1.09 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Screens: Furnish one (1) replacement screen for each size screen installed.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. **Manufacturers:** Subject to compliance with requirements, provide basis of design products indicated, or comparable products by one of the following:
1. EFCO Corporation.
 2. Kawneer.
 3. Wausau Window and Wall Systems.

2.02 ALUMINUM WINDOWS

A. **Window Types A and B:** Fixed.

1. **Basis-of-Design Product:** Subject to compliance with requirements, provide the following, or equal:
 - a. Oldcastle Building Envelope; Signature Series 3375.

B. **Window Type C:** Fixed over Awning.

1. **Basis-of-Design Product:** Subject to compliance with requirements, provide the following, or equal:
 - a. EFCO Corporation; Series 325X.

C. **AAMA/WDMA Performance Requirements:** Provide aluminum windows of performance indicated that comply with AAMA/WDMA 101/I.S.2/NAFS unless more stringent performance requirements are indicated.

1. Minimum Performance Class and Grade, Fixed: AW100.
2. Minimum Performance Class and Grade, Fixed/Project Out: AW-PG95-C.

D. **Air Infiltration:** Maximum rate not more than indicated when tested according to ASTM E 283.

1. **Maximum Rate:** 0.10 cfm/sq. ft. of area at an inward test pressure of 6.24 lbf/sq. ft. for fixed and projected units.

E. **Water Resistance:** No water leakage when tested in accordance with ASTM E 331/ASTM E 547.

1. **Test Pressure:** 15 percent of positive design pressure, but not less than 15.0 lbf/sq. ft.

- F. Condensation-Resistance Factor (CRF): Provide aluminum windows tested for thermal performance according to AAMA 1503, showing a CRF of not less than 55.
- G. Thermal Transmittance: NFRC 100 maximum whole-window U-factor of 0.38 Btu/sq. ft. x h x deg F for fixed, and 0.45 Btu/sq. ft. x h x deg F for operable units.
- H. Solar Heat-Gain Coefficient (SHGC): NFRC 200 maximum whole-window SHGC of 0.38.

2.03 MATERIALS

- A. Aluminum Framing Members:
 - 1. Extruded aluminum billet, 6063-T5 or T6 alloy for primary non-radius components; 6063-T5 or T6, 6005-T5, 6105-T5 or 6061-T6 for anchor components; all meeting the requirements of ASTM B221.
 - 2. Aluminum sheet alloy 5005-H32 (for anodic finishing), or alloy 3003-H14 (for painted or unfinished sheet) meeting the requirements of ASTM B209.
- B. Fasteners: Aluminum, nonmagnetic stainless steel, epoxy adhesive, or other materials warranted by manufacturer to be noncorrosive and compatible with aluminum window members, trim, hardware, anchors, and other components.
 - 1. Reinforcement: Where fasteners screw anchor into aluminum less than 0.125 inch thick, reinforce interior with aluminum or nonmagnetic stainless steel to receive screw threads, or provide standard, noncorrosive, pressed-in, splined grommet nuts.
 - 2. Exposed Fasteners: Unless unavoidable for applying hardware, do not use exposed fasteners. For application of hardware, use fasteners that match finish of member or hardware being fastened, as appropriate.
- C. Anchors, Clips, and Accessories: Aluminum, nonmagnetic stainless steel, or zinc-coated steel or iron complying with ASTM B 633 for SC 3 severe service conditions; provide sufficient strength to withstand design pressure indicated.
- D. Reinforcing Members: Aluminum, nonmagnetic stainless steel, or nickel/chrome-plated steel complying with ASTM B 456 for Type SC 3 severe service conditions, or zinc-coated steel or iron complying with ASTM B 633 for SC 3 severe service conditions; provide sufficient strength to withstand design pressure indicated.
- E. Compression-Type Weather Stripping: Provide compressible weather stripping designed for permanently resilient sealing under bumper or wiper action and for complete concealment when aluminum window is closed.
 - 1. Weather-Stripping Material: Manufacturer's standard system and materials complying with AAMA/WDMA 101/I.S.2/NAFS.

- F. Replaceable Weather Seals: Comply with AAMA 701/702.
- G. Sealant: For sealants required within fabricated windows, provide window manufacturer's standard, permanently elastic, nonshrinking, and nonmigrating type recommended by sealant manufacturer for joint size and movement.
 - 1. Comply with Division 7 Section "Joint Sealants" for perimeter sealants between window units and surrounding construction.

2.04 GLAZING

- A. Glass and Glazing Materials: Comply with Division 8 Section "Glazing" for insulated glass units and glazing requirements applicable to glazed aluminum window units.
- B. Glazing Materials:
 - 1. Setting Blocks/Edge Blocking: Provide in sizes and locations recommended by GANA Glazing Manual. Setting blocks used in conjunction with soft-coat low-e glass shall be silicone.
 - 2. Back-bedding tapes, expanded cellular glazing tapes, toe beads, heel beads and cap beads shall meet the requirements of applicable specifications cited in AAMA 800.
 - 3. Glazing gaskets shall be non-shrinking, weather-resistant, and compatible with all materials in contact.
 - 4. Structural silicone sealant where used shall meet the requirements of ASTM C1184.
 - 5. Spacer tape in continuous contact with structural silicone shall be tested for compatibility and approved by the sealant manufacturer for the intended application.
 - 6. Gaskets in continuous contact with structural silicone shall be extruded silicone or compatible material.

2.05 HARDWARE

- A. General: Provide manufacturer's standard hardware fabricated from aluminum, stainless steel, carbon steel complying with AAMA 907, or other corrosion-resistant material compatible with aluminum; designed to smoothly operate, tightly close, and securely lock aluminum windows, and sized to accommodate sash or ventilator weight and dimensions. Do not use aluminum in frictional contact with other metals. Where exposed, provide solid bronze.
- B. Sill Cap/Track: Extruded-aluminum track with natural anodized finish, of thickness, dimensions, and profile indicated; designed to comply with performance requirements indicated and to drain to the exterior.

- C. Locks and Latches: Designed to allow unobstructed movement of the sash across adjacent sash in direction indicated and operated from the inside only.
- D. Four- Bar Friction Hinges: Comply with AAMA 904.
 - 1. Locking mechanism and handles for manual operation.
 - 2. Friction Shoes: Provide friction shoes of nylon or other nonabrasive, nonstaining, noncorrosive, durable material.
- E. Projected Windows: Provide the following operating hardware:
 - 1. Hinge: Concealed four- bar stainless steel friction hinge located on each jamb near top rail; two per ventilator.
 - 2. Lock: Lift-type throw, cam-action lock with keeper; two per ventilator.
 - 3. Pole Operators: Tubular-shaped anodized aluminum; with rubber-capped lower end and standard push-pull hook at top to match hardware design; of sufficient length to operate window without reaching more than 60 inches above floor; one pole operator and pole hanger per room that has operable windows more than 72 inches above floor.
- F. Weather Stripping: Provide full-perimeter weather stripping for each operable sash unless otherwise indicated.
- G. Fasteners: Noncorrosive and compatible with window members, trim, hardware, anchors, and other components.
 - 1. Exposed Fasteners: Do not use exposed fasteners to greatest extent possible. For application of hardware, use fasteners that match finish hardware being fastened.

2.06 INSECT SCREENS

- A. General: Design windows and hardware to accommodate screens in a tight-fitting, removable arrangement, with a minimum of exposed fasteners and latches. Fabricate insect screens to fully integrate with window frame. Locate screens on outside of window and provide for each operable exterior sash or ventilator.
 - 1. Comply with SMA 1004, "Specifications for Aluminum Tubular Frame Screens for Windows," for minimum standards of appearance, fabrication, attachment of screen fabric, hardware, and accessories unless more stringent requirements are indicated.
- B. Aluminum Insect Screen Frames: Manufacturer's standard aluminum alloy complying with SMA 1004. Fabricate frames with mitered or coped joints or corner extrusions, concealed fasteners, and removable PVC spline/anchor concealing edge of frame.
 - 1. Aluminum Tubular Framing Sections and Cross Braces: Roll formed from aluminum sheet with minimum wall thickness as required for class indicated.

2. Extruded-Aluminum or Aluminum Tubular Framing Sections and Cross Braces: Not less than 0.050-inch wall thickness.
 3. Finish: Match aluminum window members.
- C. Aluminum Wire Fabric: 18-by-16 mesh of 0.011-inch- diameter, coated aluminum wire.
1. Wire-Fabric Finish: Charcoal gray.

2.07 ACCESSORIES

- A. Joint Sealants: Comply with Division 7 Section "Joint Sealants."
- B. Panning:
1. Provide extruded aluminum panning to receive replacement windows as shown on architectural drawings.
 2. Panning shall be pre-assembled and all joinery back-sealed prior to installation.
 3. Finish to match window frames.
- C. Receptors:
1. Provide extruded aluminum receptors to receive windows, as shown on architectural drawings.
 2. Finish to match window frames.

2.08 ACCESSORY MATERIALS

- A. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos, formulated for 30-mil thickness per coat.
- B. Unfaced, Mineral-Wool Blanket Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers; with maximum flame-spread and smoke-developed indexes of 0, per ASTM E 84; passing ASTM E 136 for combustion characteristics.
1. Manufacturers: Subject to compliance with requirements, provide one of the following:
 - a. Johns Manville; MinWool Sound Attenuation Fire Batts (SAFB).
 - b. Rockwool; COMFORTBATT.
 - c. Thermafiber; SAFB.
 2. R-Value: Minimum 3.5 per inch.
 3. Nominal density of 2.0 lbs/cu. ft minimum.

2.09 FABRICATION

- A. Fabricate aluminum windows in sizes indicated. Include a complete system for assembling components and anchoring windows.
 - 1. Principal window frame and sash ventilator members will be a minimum 0.094" in thickness at glazing legs, hardware mounting webs and section flanges.
 - 2. Extruded or formed trim components will be a minimum 0.060" in thickness.
 - 3. Frame depth:
 - a. Fixed Units: 3-3/8 inches.
 - b. Fixed/Awning Units: 3-1/4 inches.
- B. Fabricate aluminum windows that are reglazable without dismantling sash or ventilator framing.
- C. Thermally Improved Construction: Fabricate aluminum windows with an integral, concealed, low-conductance thermal barrier; located between exterior materials and window members exposed on interior side; in a manner that eliminates direct metal-to-metal contact.
 - 1. Provide thermal-break construction that has been in use for not less than three years and has been tested to demonstrate resistance to thermal conductance and condensation and to show adequate strength and security of glass retention.
 - a. Thermal barrier: Insulbar or equal, consisting of two glass reinforced polyamide nylon 6/6 struts mechanically crimped in raceways extruded in the exterior and interior extrusions.
 - b. Poured and debrided urethane thermal barriers are not permitted.
 - 2. Provide thermal barriers tested according to AAMA 505; determine the allowable design shear flow per the appendix in AAMA 505.
- D. Weep Holes: Provide weep holes and internal passages to conduct infiltrating water to exterior.
- E. Provide water-shed members above side-hinged ventilators and similar lines of natural water penetration.
- F. Subframes: Provide subframes with anchors for window units as shown, of profile and dimensions indicated but not less than 0.062-inch- thick extruded aluminum. Miter or cope corners, and weld and dress smooth with concealed mechanical joint fasteners. Finish to match window units. Provide subframes capable of withstanding design loads of window units.
- G. Factory-Glazed Fabrication: Glaze aluminum windows in the factory. Comply with requirements in Division 8 Section "Glazing" and with AMA/WDMA 101/LS.2/NAFS.

- H. Glazing Stops: Provide snap-on glazing stops coordinated with Division 8 Section "Glazing" and glazing system indicated. Provide glazing stops to match sash and ventilator frames.

2.10 FINISHES, GENERAL

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.11 ALUMINUM FINISHES

- A. High-Performance Organic Finish: Two-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - 1. Color: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work. Verify rough opening dimensions, levelness of sill plate, and operational clearances. Examine wall flashings, vapor retarders, water and weather barriers, and other built-in components to ensure a coordinated, weathertight window installation.
 - 1. Masonry Surfaces: Visibly dry and free of excess mortar, sand, and other construction debris.
 - 2. Metal Surfaces: Dry; clean; free of grease, oil, dirt, rust, corrosion, and welding slag; without sharp edges or offsets at joints.
 - 3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Comply with Drawings, Shop Drawings, and manufacturer's written instructions for installing windows, hardware, accessories, and other components.
- B. Install windows level, plumb, square, true to line, without distortion or impeding thermal movement, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction.
 - 1. Install windows from the exterior.
 - 2. Maintain 3/8-inch joint around entire window.
 - 3. Set windows in receptors in wet glaze sealant.
- C. Set sill members in bed of sealant or with gaskets, as indicated, for weathertight construction.
- D. Install windows and components to drain condensation, water penetrating joints, and moisture migrating within windows to the exterior.
- E. Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials.
- F. Install mineral wool insulation at head and in jambs as indicated.
- G. Install perimeter joint sealants specified in Division 7 Section "Joint Sealants."

3.03 FIELD QUALITY CONTROL

- A. Field testing to be performed by a third part testing agent retained by the Contractor.
 - 1. Testing and inspecting agency will interpret tests and state in each report whether tested work complies with or deviates from requirements.
- B. Testing Services: Testing and inspecting of installed windows shall take place as follows:
 - 1. Testing Methodology: Testing of windows for air infiltration and water resistance shall be performed according to AAMA 502.
 - 2. Air-Infiltration Testing: In accordance with ASTM E 783 Field Measurement of Air Through Installed Exterior Windows and Doors.
 - a. Test Pressure: That required to determine compliance with AAMA/WDMA/CSA 101/I.S.2/A440 performance class indicated.
 - b. Allowable Air-Leakage Rate: 1.5 times the applicable AAMA/WDMA/CSA 101/I.S.2/A440 rate for product type and performance class rounded down to one decimal place.

3. Water-Resistance Testing: In accordance with ASTM E 1105 Field Determination of Water Penetration of Installed Exterior Windows, Curtain Walls, and Doors by Uniform or Cyclic Static Air Pressure Difference.
 - a. Test Pressure: Two-thirds times test pressure required to determine compliance with AAMA/WDMA/CSA 101/I.S.2/A440 performance grade indicated.
 - b. Allowable Water Infiltration: No water penetration.
4. Testing Extent: Test windows as selected by the Commissioning agent and a qualified independent testing and inspecting agency. Windows shall be tested immediately after complete installation.
 - a. Test two (2) windows representing different sizes/types, tested per Method A, prior to installation of 10 percent of each size/type. Perform corrective action and retesting until specified levels of performance are achieved.
 - b. Upon successful resolution of performance established by Method A, test one (1) typical assembly or bay of multiple windows per Method B to establish an actual level of performance for installed window system.
 - c. Test six (6) additional, randomly selected windows, three (3) per day on two separate dates, of the same size/type originally tested, between installation of 25 and 100 percent of each size/type.
5. Test Reports: Shall be prepared according to AAMA 502-12 Voluntary Specification for Field Testing of Newly Installed Fenestration Products.
 - C. Remove and replace noncomplying aluminum windows and retest as specified above.
 - D. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.04 ADJUSTING, CLEANING, AND PROTECTION

- A. Clean aluminum surfaces immediately after installing windows. Avoid damaging protective coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances.
- B. Clean glass immediately after installing windows. Comply with manufacturer's written recommendations for final cleaning and maintenance. Remove nonpermanent labels, and clean surfaces.
- C. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.

- D. Protect window surfaces from contact with contaminating substances resulting from construction operations. In addition, monitor window surfaces adjacent to and below exterior concrete and masonry surfaces during construction for presence of dirt, scum, alkaline deposits, stains, or other contaminants. If contaminating substances do contact window surfaces, remove contaminants immediately according to manufacturer's written recommendations.

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 08710

DOOR HARDWARE

PART 1 - GENERAL

1.01 GENERAL PROVISIONS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 DESCRIPTION OF WORK

- A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:
 - 1. Door Hardware
- B. Related Work: The following items are not included in this Section and are specified under the designated Sections:
 - 1. Division 08 Section "Hollow Metal Doors and Frames" to coordinate hardware for doors and frames.
 - 2. Division 10 Section "Wire Mesh Partitions" for wire mesh partition swing door.
 - 3. Division 16 Sections for electrical connections including conduit and wiring for door controls.

1.03 SUBMITTALS

- A. Product Data: Product data including manufacturers' technical product data for each item of door hardware, installation instructions, maintenance of operating parts and finish, and other information necessary to show compliance with requirements.
- B. Samples for Verification: As requested by Architect, submit production sample or sample installations of each type of exposed hardware unit in finish indicated, and tagged with full description for coordination with schedule.
 - 1. Samples will be returned to supplier in like-new condition. Units that are acceptable to Architect may, after final check of operations, be incorporated into Work, within limitations of key coordination requirements.

2. Door Hardware Schedule: Submit schedule with hardware sets in vertical format as illustrated by Sequence of Format for the Hardware Schedule as published by the Door and Hardware Institute. Indicate complete designations of each item required for each door or opening, include:
 - a. Door Index; include door number, heading number, and Architects hardware set number.
 - b. Opening Lock Function Spreadsheet: List locking device and function for each opening.
 - c. Type, style, function, size, and finish of each hardware item.
 - d. Name and manufacturer of each item.
 - e. Fastenings and other pertinent information.
 - f. Location of each hardware set cross-referenced to indications on Drawings.
 - g. Explanation of all abbreviations, symbols, and codes contained in schedule.
 - h. Mounting locations for hardware.
 - i. Door and frame sizes and materials.
 - j. Name and phone number for local manufacturer's representative for each product.
 - k. Operational Description of openings with any electrified hardware (locks, exits, electromagnetic locks, electric strikes, automatic operators, door position switches, magnetic holders or closer/holder units, and access control components). Operational description should include how door will operate on egress, ingress, and fire and smoke alarm connection.
 1. Submittal Sequence: Submit door hardware schedule concurrent with submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate fabrication of other work that is critical in Project construction schedule.

C. Key Schedule:

1. After Keying Conference, provide keying schedule listing levels of keying as well as explanation of key system's function, key symbols used and door numbers controlled.
2. Use ANSI A156.28 "Recommended Practices for Keying Systems" as guideline for nomenclature, definitions, and approach for selecting optimal keying system.
3. Provide 3 copies of keying schedule for review prepared and detailed in accordance with referenced DHI publication. Include schematic keying diagram and index each key to unique door designations.
4. Index keying schedule by door number, keyset, hardware heading number, cross keying instructions, and special key stamping instructions.
5. Provide one complete bitting list of key cuts and one key system schematic illustrating system usage and expansion.

- a. Forward bitting list, key cuts and key system schematic directly to Owner, by means as directed by Owner.
6. Prepare key schedule by or under supervision of supplier, detailing Owner's final keying instructions for locks.
7. Templates: After final approval of hardware schedule, provide templates for doors, frames and other work specified to be factory prepared for door hardware installation.

D. Informational Submittals:

1. Qualification Data: For Supplier, Installer and Architectural Hardware Consultant.
2. Product Certificates for electrified door hardware, signed by manufacturer:
 - a. Certify that door hardware approved for use on types and sizes of labeled fire-rated doors complies with listed fire-rated door assemblies.
3. Certificates of Compliance:
 - a. Certificates of compliance for fire-rated hardware and installation instructions if requested by Architect or Authority Having Jurisdiction.
 - b. Installer Training Meeting Certification: Letter of compliance, signed by Contractor, attesting to completion of installer training meeting specified in "QUALITY ASSURANCE" article, herein.
4. Product Test Reports: For compliance with accessibility requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by qualified testing agency, for door hardware on doors located in accessible routes.
5. Warranty: Special warranty specified in this Section.

E. Closeout Submittals:

1. Operations and Maintenance Data: Provide in accordance with Division 01 and include:
 - a. Complete information on care, maintenance, and adjustment; data on repair and replacement parts, and information on preservation of finishes.
 - b. Catalog pages for each product.
 - c. Name, address, and phone number of local representatives for each manufacturer.
 - d. Parts list for each product.
 - e. Final approved hardware schedule edited to reflect conditions as installed.

- f. Final keying schedule
- g. Copies of floor plans with keying nomenclature
- h. As-installed wiring diagrams for each opening connected to power, both low voltage and 110 volts. (as required)
- i. Copy of warranties including appropriate reference numbers for manufacturers to identify project.

1.04 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers trained and approved by manufacturer.
- B. Source Limitations: Obtain standard hardware through one source from a single manufacturer.
- C. Product Substitutions: Comply with product requirements stated in Division 01 and as specified herein.
 - 1. Where specific manufacturer's product is named and accompanied by "No Substitute," including make or model number or other designation, provide product specified. (Note: Certain products have been selected for their unique characteristics and particular project suitability.)
 - a. Where no additional products or manufacturers are listed in product category, requirements for "No Substitute" govern product selection.
 - 2. Where products indicate "acceptable substitute" or "acceptable manufacturer", provide product from specified manufacturers, subject to compliance with specified requirements and "Single Source Responsibility" requirements stated herein.
- D. Supplier Qualifications and Responsibilities: Recognized architectural hardware supplier with record of successful in-service performance for supplying door hardware similar in quantity, type, and quality to that indicated for this Project and that provides certified Architectural Hardware Consultant (AHC) available to Owner, Architect, and Contractor, at reasonable times during the Work for consultation.
 - 1. Warehousing Facilities: In Project's vicinity.
 - 2. Scheduling Responsibility: Preparation of door hardware and keying schedules.
 - 3. Engineering Responsibility: Preparation of data for electrified door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.

4. Coordination Responsibility: Coordinate installation of electronic security hardware with Architect and electrical engineers and provide installation and technical data to Architect and other related subcontractors.
 - a. Upon completion of electronic security hardware installation, inspect and verify that all components are working properly.
- E. Installer Qualifications: Qualified tradesmen, skilled in application of commercial grade hardware with record of successful in-service performance for installing door hardware similar in quantity, type, and quality to that indicated for this Project.
- F. Architectural Hardware Consultant Qualifications: Person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and meets these requirements:
 1. For door hardware, DHI-certified, Architectural Hardware Consultant (AHC).
 2. Can provide installation and technical data to Architect and other related subcontractors.
 3. Can inspect and verify components are in working order upon completion of installation.
 4. Capable of producing wiring diagrams.
 5. Capable of coordinating installation of electrified hardware with Architect and electrical engineers.
- G. Single Source Responsibility: Obtain each type of door hardware from single manufacturer.
 1. Provide electrified door hardware from same manufacturer as mechanical door hardware, unless otherwise indicated.
 2. Manufacturers that perform electrical modifications and that are listed by testing and inspecting agency acceptable to authorities having jurisdiction are acceptable.
- H. Fire-Rated Door Openings: Provide door hardware for fire-rated openings that complies with NFPA 80 and requirements of authorities having jurisdiction. Provide only items of door hardware that are listed and are identical to products tested by Underwriters Laboratories, Intertek Testing Services, or other testing and inspecting organizations acceptable to authorities having jurisdiction for use on types and sizes of doors indicated, based on testing at positive pressure and according to NFPA 252 or UL 10C and in compliance with requirements of fire-rated door and door frame labels.
- I. Means of Egress Doors: Latches do not require more than 15 lbf (67 N) to release latch. Locks do not require use of key, tool, or special knowledge for operation.

- J. Accessibility Requirements: For door hardware on doors in an accessible route, comply with governing accessibility regulations cited in “REFERENCES” article, herein.
 - 1. Provide operating devices that do not require tight grasping, pinching, or twisting of wrist and that operate with force of not more than 5 lbf.
 - 2. Maximum opening-force requirements:
 - a. Interior, Non-Fire-Rated Hinged Doors: 5 lbf applied perpendicular to door.
 - b. Fire Doors: Minimum opening force allowable by authorities having jurisdiction.
 - 3. Bevel raised thresholds with slope of not more than 1:2. Provide thresholds not more than 1/2 inch (13 mm) high.
 - 4. Adjust door closer sweep periods so that, from open position of 70 degrees, door will take at least 3 seconds to move to 3 inches (75 mm) from latch, measured to leading edge of door.

- K. Keying Conference: Conduct conference at Project site to comply with requirements in Division 01.
 - 1. Attendees: Owner, Contractor, Architect, and Supplier’s Architectural Hardware Consultant.
 - 2. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including:
 - a. Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
 - b. Preliminary key system schematic diagram.
 - c. Requirements for key control system.
 - d. Requirements for access control.
 - e. Address for delivery of keys.

- L. Coordination Conferences:
 - 1. Installation Coordination Conference: Prior to hardware installation, schedule and hold meeting to review questions or concerns related to proper installation and adjustment of door hardware.
 - a. Attendees: Door Hardware Supplier, Door Hardware Installer, Architect, Contractor and Owners Representative.
 - b. After meeting, provide letter of compliance to Architect, indicating when meeting was held and who was in attendance.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up for hardware delivered to Project site.
- B. Tag each item or package separately with identification coordinated with final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package.
 - 1. Deliver each article of hardware in manufacturer's original packaging.
- C. Project Conditions:
 - 1. Maintain manufacturer-recommended environmental conditions throughout storage and installation periods.
 - 2. Provide secure lock-up for door hardware delivered to Project, but not yet installed. Control handling and installation of hardware items so that completion of Work will not be delayed by hardware losses both before and after installation.
- D. Protection and Damage:
 - 1. Promptly replace products damaged during shipping.
 - 2. Handle hardware in manner to avoid damage, marring, or scratching. Correct, replace or repair products damaged during Work.
 - 3. Protect products against malfunction due to paint, solvent, cleanser, or any chemical agent.
- E. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.
 - 1. Deliver keys and permanent cores to Owner by registered mail or overnight package service.

1.06 PROJECT CONDITIONS

- A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.07 COORDINATION

- A. Installation Templates: Distribute for doors, frames, and other work specified to be factory prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

- B. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant.
- C. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.
- D. Direct shipments not permitted, unless approved by Contractor.

1.08 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fails in materials or workmanship within specified warranty period.

- 1. Warranty Period: Years from date of Substantial Completion, for durations indicated.
 - a. Closers:
 - b. Mechanical: 10 years.
 - c. Electrified: 2 years.
 - d. Exit Devices:
 - e. Mechanical: 3 years.
 - f. Electrified: 1 year.
 - g. Locksets:
 - h. Mechanical: 3 years.
 - i. Electrified: 1 year.
 - j. Continuous Hinges: Lifetime warranty.
 - k. Continuous Hinges: 10 years.
 - l. Key Blanks: Lifetime
- 2. Warranty does not cover damage or faulty operation due to improper installation, improper use or abuse.

1.09 MAINTENANCE

- A. Maintenance Tools:
 - 1. Furnish complete set of special tools required for maintenance and adjustment of hardware, including changing of cylinders.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. The Owner requires use of certain products for their unique characteristics and particular project suitability to insure continuity of existing and future performance and maintenance standards. After investigating available product offerings Awarding Authority has elected to prepare proprietary specifications. These products are specified with the notation: “No Substitute.”
 - 1. Where “No Substitute” is noted, submittals and substitution requests for other products will not be considered.

- B. Approval of manufacturers other than those listed shall be in accordance with QUALITY ASSURANCE article, herein.

- C. Approval of products from manufacturers indicated as “Acceptable Manufacturer” is contingent upon those products providing all functions and features and meeting all requirements of scheduled manufacturer’s product.

Item	Scheduled Manufacturer	Acceptable Manufacturer
Hinges	Ives (IVE)	Bommer, Hager
Flush Bolts & Coordinators	Ives (IVE)	Burns, Hiawatha
Locksets & Deadlocks	Schlage (SCH)	
Exit Devices & Mullions	Von Duprin (VON)	
Cylinders & Keying	Schlage (SCH)	
Key Cabinets	Telkee (TEL)	HPC, Lund
Door Closers	LCN (LCN)	
Door Trim	Ives (IVE)	Burns, Hiawatha
Protection Plates	Ives (IVE)	Burns, Hiawatha
Overhead Stops	Glynn-Johnson (GLY)	ABH, Rixson
Stops & Holders	Ives (IVE)	Burns, Hiawatha
Thresholds & Weather-strip	National Guard Products (NGP)	Reese, Zero
Silencers	Ives (IVE)	Burns, Hiawatha
Magnetic Holders	LCN (LCN)	ABH, DynaLock
Door Position Switches	By Other (B/O)	

- D. Hand of Door: Drawings show direction of slide, swing, or hand of each door leaf. Furnish each item of hardware for proper installation and operation of door movement as shown.
- E. Where specified hardware is not adaptable to finished shape or size of members requiring hardware, furnish suitable types having same operation and quality as type specified, subject to Architect's approval.

2.02 MATERIALS

- A. Fasteners
 - 1. Provide hardware manufactured to conform to published templates, generally prepared for machine screw installation.
 - 2. Furnish screws for installation with each hardware item. Finish exposed (exposed under any condition) screws to match hardware finish, or, if exposed in surfaces of other work, to match finish of this other work including prepared for paint surfaces to receive painted finish.
 - 3. Provide concealed fasteners for hardware units exposed when door is closed except when no standard units of type specified are available with concealed fasteners. Do not use thru-bolts for installation where bolt head or nut on opposite face is exposed in other work unless thru-bolts are required to fasten hardware securely. Review door specification and advise Architect if thru-bolts are required.
 - 4. Install hardware with fasteners provided by hardware manufacturer.
- B. Provide screws, bolts, expansion shields, drop plates and other devices necessary for hardware installation.
 - 1. Where fasteners are exposed to view: Finish to match adjacent door hardware material.

2.03 HINGES, TEMPLATE

- A. Provide template-produced hinges for hinges installed on hollow-metal doors and hollow-metal frames.
- B. Requirements:
 - 1. Minimum Size, Gauge and Weight of Hinge:
 - a. 1-3/4 inch (44 mm) thick doors, up to and including 36 inches (914 mm) wide:
 - 1) Exterior: Standard weight 0.134 gauge, bronze or stainless steel, 4-1/2 inches (114 mm) high
 - 2) Interior: Standard weight 0.134 gauge, steel, 4-1/2 inches (114 mm) high

- b. 1-3/4 inch (44 mm) thick doors over 36 inches (914 mm) wide:
 - 1) Exterior: Heavy weight 0.190 gauge, bronze/stainless steel, 5 inches (127 mm) high
 - 2) Interior: Heavy weight 0.190 gauge, steel, 5 inches (127 mm) high
 - c. 2 inches or thicker doors:
 - 1) Exterior: Heavy weight 0.190 gauge, bronze or stainless steel, 5 inches (127 mm) high
 - 2) Interior: Heavy weight (0190 gauge, steel, 5 inches (127 mm) high
 - d. High frequency doors provide heavy weight hinges or where indicated in Hardware Set.
2. Minimum number of Hinges:
 - a. Doors 60 inches (1524mm) or less in height: Two (2) each.
 - b. Doors over 60 inches (1524mm) and 90 inches (2286mm) or less in height: Three (3) each.
 - c. Door over 90 inches (2286mm): One (1) for each additional hinge 30 inches (762mm) of height or fraction thereof.
 - d. Dutch Door: Four (4) each.
 3. Where new hinges are specified for existing doors or existing frames, provide new hinges of identical size to hinge preparation present in existing door or existing frame.
 4. Hinge Pins: Except as otherwise indicated, provide hinge pins as follows:
 - a. Steel Hinges: Steel pins
 - b. Non-Ferrous Hinges: Stainless steel pins
 - c. Out-Swinging Exterior Doors: Non-removable pins
 - d. Out-Swinging Interior Lockable Doors: Non-removable pins
 - e. Interior Non-lockable Doors: Non-rising pins
 5. Electrified Hinges:
 - a. Through-Wire Hinge; provide with tamper-resistant fully concealed wires in the quantity and gauge to accommodate the electrical function of specified hardware.
 - 1) Electrical requirements; 50 volts AC/DC at 3.5 amps continuous with 16 amps pulse.
 - b. Monitor Hinge; provide full concealed tamper-resistant monitor switch.
 - 1) Electrical requirements; 30 VDC at .5 amps.
 - c. Locate electrical hinge at the second hinge from the bottom or nearest to electrified locking component.
 - d. Provide junction box/mortar guard for each electrified hinge specified, unless specified in the hollow metal frame specification.

- C. Provide five-knuckle, ball bearing hinges.
 - 1. Manufacturers and Products:
 - a. Scheduled Manufacturer and Product:
 - 1) Ives 5BB series.
 - b. Acceptable Manufacturers and Products:
 - 1) Bommer BB5000 series
 - 2) Hager BB series.
 - 3) McKinney TA/T4A series.
 - 4) Stanley FBB Series.

2.04 FLUSH BOLTS

- A. Requirements:
 - 1. Provide automatic, constant latching, and manual flush bolts with forged bronze or stainless steel face plates, extruded brass levers, and with wrought brass guides and strikes. Provide 12 inch (305 mm) steel or brass rods at doors up to 90 inches (2286 mm) in height. For doors over 90 inches (2286 mm) in height increase top rods by 6 inches (152 mm) for each additional 6 inches (152 mm) of door height. Provide dust- proof strikes at each bottom flush bolt.
- B. Manufacturers:
 - 1. Scheduled Manufacturer:
 - a. Ives
 - 2. Acceptable Manufacturers:
 - a. Burns
 - b. Hiawatha

2.05 COORDINATORS

- A. Requirements:
 - 1. Where pairs of doors are equipped with automatic flush bolts, an astragal, or other hardware that requires synchronized closing of the doors, provide bar-type coordinating device, surface applied to underside of stop at frame head.
 - 2. Provide filler bar of correct length for unit to span entire width of opening, and appropriate brackets for parallel arm door closers and surface vertical rod exit device strikes.
 - 3. Factory-prep coordinators for vertical rod devices if required.
- B. Manufacturers:
 - 1. Scheduled Manufacturer:
 - a. Ives
 - 2. Acceptable Manufacturers:
 - a. Burns
 - b. Hiawatha

2.06 MORTISE LOCKS

A. Requirements:

1. Provide mortise locks certified as ANSI A156.13, Grade 1 Operational, Grade 1 Security, and manufactured from heavy gauge steel, containing components of steel with a zinc dichromate plating for corrosion resistance. Provide lock case that is multi-function and field reversible for handing without opening case. Cylinders: Refer to “KEYING” article, herein.
2. Provide locks with standard 2-3/4 inches (70 mm) backset with full 3/4 inch (19 mm) throw stainless steel mechanical anti-friction latchbolt. Provide deadbolt with full 1 inch (25 mm) throw, constructed of stainless steel.
3. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim.
4. Provide electrical options as scheduled. Provide electrified locksets with micro switch (RX) option that monitors retractor crank, and is actuated when rotation of inside or outside lever rotates retractor hub. Provide normally closed contacts or normally open contacts as required by security system.
5. Lever Trim: Solid brass, bronze, or stainless steel, cast or forged in design specified, with wrought roses and external lever spring cages. Provide thru-bolted levers with 2-piece spindles.
 - a. Lever Design: Schlage 06A.
 - b. Tactile Warning (Knurling): Where required by authority having jurisdiction. Provide on levers on exterior (secure side) of doors serving rooms considered to be hazardous.

B. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
 - a. Schlage L9000 series No Substitution

2.07 EXIT DEVICES

A. Requirements:

1. Provide exit devices tested to ANSI/BHMA A156.3 Grade 1, and UL listed for Panic Exit or Fire Exit Hardware. Cylinders: Refer to “KEYING” article, herein.
2. Provide touchpad type exit devices, fabricated of brass, bronze, stainless steel, or aluminum, plated to standard architectural finishes to match balance of door hardware.
3. Quiet Operation: Incorporate fluid damper or other device that eliminates noise of exit device operation.
4. Touchpad: Extend minimum of one half of door width, but not the full length of exit device rail. Provide end-cap with two-point attachment to door. Match exit device finish, stainless steel for US26, US26D, US28, US32, and US32D finishes; and for all other finishes, provide compatible finish to exit device. Provide

compression springs in devices, latches, and outside trims or controls; tension springs prohibited.

5. Provide exit devices with deadlatching feature for security and for future addition of alarm kits and/or other electrical requirements.
6. Provide exit devices with manufacturer's approved strikes.
7. Provide exit devices cut to door width and height. Locate exit devices at height recommended by exit device manufacturer, allowable by governing building codes, and approved by Architect.
8. Mount mechanism case flush on face of doors, or provide spacers to fill gaps behind devices. Where glass trim or molding projects off face of door, provide glass beadkits.
9. Dogging:
 - a. Provide cylinder dogging (CD) at non-fire-rated exit devices, unless specified less dogging (LD).
10. Where lever handles are specified as outside trim for exit devices, provide heavy-duty lever trims with forged or cast escutcheon plates. Provide vandal-resistant levers that will travel to 90-degree down position when more than 35 pounds of torque are applied, and which can easily be re-set.
 - a. Lever Style: Match lever style of locksets.
 - b. Tactile Warning (Knurling): Where required by authority having jurisdiction. Provide on levers on exterior (secure side) of doors serving rooms considered to be hazardous.
11. Provide UL labeled fire exit hardware for fire rated openings.
12. Provide factory drilled weep holes for exit devices used in full exterior application, highly corrosive areas, and where noted in hardware sets.
13. Provide electrical options as scheduled.

B. Manufacturer and Product:

1. Von Duprin 98/35 series No Substitution

2.08 CYLINDERS

A. Requirements: Provide cylinders/cores complying with the following requirements.

1. Cylinders/cores compliant with ANSI/BHMA A156.5; latest revision, Section 12, Grade 1; permanent cylinders; cylinder face finished to match lockset, manufacturer's series as indicated.

B. Provide full-sized cylinders with permanent full size interchangeable core (FSIC) in the below- listed configuration(s), distributed throughout the Project as indicated.

1. Conventional: Everest T cylinder with a patented, restricted keyway.

C. Features: Cylinders/cores shall incorporate the following features.

1. Patent Protection: Cylinders/cores requiring use of restricted, patented keys, patent- protected until the year, 2029.

2. Nickel silver bottom pins.
3. Identification Stamping:
 - a. Stamp permanent cores with Concealed Key Control (CKC) with either keyset or unique symbol furnished by the owner.
 - b. Identification stamping provisions must be approved by the Architect and Owner.
 - c. Failure to comply with stamping requirements shall be cause for replacement of cylinders/cores involved at no additional cost to Owner.
- D. Shipping: Forward cylinders/cores to Owner, separately from keys, by means as directed by Owner. See paragraph 1.6 DELIVERY, STORAGE AND HANDLING
- E. Replaceable Construction Cores.
 1. Provide temporary construction cores replaceable by permanent cores, furnished in accordance with the following requirements.
 2. Owner or Owner's Representative will replace temporary construction cores with permanent cores.
- F. Manufacturer and Product:
 1. Scheduled Manufacturer and Product: Schlage Everest 29, No Substitute

2.09 KEYING

- A. Keying System: Factory registered, complying with guidelines in ANSI/BHMA A156.28, incorporating decisions made at keying conference.
- B. Keying Requirements – General
 1. Provide keying system capable of multiplex master keying with a 4-level hierarchy.
 2. Permanent cylinders/cores keyed by the manufacturer according to the following key system.
 - a. Grand Master Key System: Cylinders/cores operated by change (day) keys, master key and grand master key.
 3. Forward bitting list and keys separately from cylinders, by means as directed by Owner. Failure to comply with forwarding requirements shall be cause for replacement of cylinders/cores involved at no additional cost to Owner.
- C. Key Features: Provide keys with the following features.
 1. Patent Protection: Keys and blanks protected by one or more utility patent(s) until the year, 2029.
- D. Keys
 1. Material: Nickel silver; minimum thickness of .107-inch (2.3mm)

2. Identification:
 - a. Coordinate with cylinder/core and key identification requirements above.
 - b. Stamp permanent keys with Visual Key Control (VKC) either with keyset symbol or unique symbol furnished by the owner.
 - c. Stamp keys with Owner's unique key system facility code as established by the manufacturer
 - d. Stamp keys with "DO NOT DUPLICATE" along with the "PATENTED" or patent number to enforce the patent protection.
 - e. Identification stamping provisions must be approved by the Architect and Owner.
 - f. Failure to comply with stamping requirements shall be cause for replacement of keys involved at no additional cost to Owner.

3. Cut Keys: Furnish in the following quantities.
 - a. Change (Day) Keys: Three (3) per cylinder/core.
 - b. Keyed Alike set: Six (6) each or as directed by owner.
 - c. Permanent Control Keys: Three (3) each.
 - d. Master Keys (MK): Six (6) each per master.
 - e. Grand Master Keys (GMK): Six (6) each per grand master.
 - f. Unused balance of key blanks shall be furnished to Owner with the cut keys.

4. Special Keys: Furnish in the following quantities.
 - a. Construction Keys: Ten (10) each.
 - b. Construction Control Keys: Three (3) each.

2.10 KEY STORAGE SYSTEM

- A. Key Control System Requirements:
 1. Provide key control system, including envelopes, labels, tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent markers, and standard metal cabinet, all as recommended by system manufacturer, with capacity for 150% of number of locks required for Project.
 - a. Provide complete cross index system set up by hardware supplier, and place keys on markers and hooks in cabinet as determined by final key schedule.
 - b. Provide hinged-panel type cabinet for wall mounting.

- B. Manufacturers:
 1. Scheduled Manufacturer:
 - a. Telkee
 2. Acceptable Manufacturers:
 - a. HPC
 - b. Lund

2.11 SURFACE DOOR CLOSERS

A. Closer Requirements:

1. Provide door closers certified to ANSI/BHMA A156.4 Grade 1 requirements by BHMA certified independent testing laboratory. Certify surface mounted mechanical closers to exceed ten million (10,000,000) full load cycles. ISO 9000 certify closers. Stamp units with date of manufacture code.
2. Provide door closers with fully hydraulic, full rack and pinion action with high strength cast iron cylinder, and full complement bearings at shaft.
3. Cylinder Body: 1-1/2 inch (38 mm) diameter with 11/16 inch (17 mm) diameter double heat-treated pinion journal.
4. Hydraulic Fluid: Fireproof, passing requirements of UL10C, and requiring no seasonal closer adjustment for temperatures ranging from 120 degrees F to -30 degrees F.
5. Spring Power: Continuously adjustable over full range of closer sizes, and providing reduced opening force as required by accessibility codes and standards.
6. Hydraulic Regulation: By tamper-proof, non-critical valves, with separate adjustment for latch speed, general speed, and backcheck.
7. Provide closers with solid forged steel main arms and factory assembled heavy-duty forged forearms for parallel arm closers. When closers are parallel arm mounted, provide closers which mount within 6-inch (152 mm) top rail without use of mounting plate so that closer is not visible through vision panel from pull side.
8. Pressure Relief Valve (PRV) Technology: Not permitted.
9. Finish for Closer Cylinders, Arms, Adapter Plates, and Metal Covers: Powder coating finish which has been certified to exceed 100 hours salt spray testing as described in ANSI Standard A156.4 and ASTM B117, or has special rust inhibitor (SRI).
10. Provide special templates, drop plates, mounting brackets, or adapters for arms as required for details, overhead stops, and other door hardware items interfering with closer mounting.

B. Manufacturer and Product:

1. LCN 4040XP series. No Substitute

2.12 PROTECTION PLATES

A. Requirements:

1. Provide kick plates, mop plates, and armor plates minimum of 0.050 inch (1 mm) thick as scheduled. Furnish with sheet metal or wood screws, finished to match plates.
2. Sizes of plates:
 - a. Kick Plates: 10 inches (254 mm) high by 2 inches (51 mm) less width of door on single doors, 1 inch (25 mm) less width of door on pairs
 - b. Mop Plates: 10 inches (102 mm) high by 2 inches (51 mm) less width of door on single doors, 1 inch (25 mm) less width of door on pairs

B. Manufacturers:

1. Scheduled Manufacturer:
 - a. Ives
2. Acceptable Manufacturers:
 - a. Burns
 - b. Hiawatha

2.13 OVERHEAD STOPS AND OVERHEAD STOP/HOLDERS

A. Requirements:

1. Provide heavy duty concealed mounted overhead stop or holder as specified for exterior and interior vestibule single acting doors.
2. Provide heavy duty concealed mounted overhead stop or holder as specified for double acting doors.
3. Provide heavy or medium duty and concealed or surface mounted overhead stop or holder for interior doors as specified. Provide medium duty surface mounted overhead stop for interior doors and at any door that swings more than 140 degrees before striking wall, open against equipment, casework, sidelights, and where conditions do not allow wall stop or floor stop presents tripping hazard.
4. Where overhead holders are specified provide friction type at doors without closer and positive type at doors with closer.

B. Manufacturers:

1. Scheduled Manufacturers:
 - a. Glynn-Johnson
2. Acceptable Manufacturers:
 - a. ABH
 - b. Rixson

2.14 DOOR STOPS AND HOLDERS

- A. Provide door stops at each door leaf:
 - 1. Provide wall stops wherever possible. Provide convex type where mortise type locks are used and concave type where cylindrical type locks are used.
 - 2. Where a wall stop cannot be used, provide universal floor stops for low or high rise options.
 - 3. Where wall or floor stop cannot be used, provide medium duty surface mounted overhead stop.

- B. Manufacturers:
 - 1. Scheduled Manufacturer:
 - a. Ives.
 - 2. Acceptable Manufacturers:
 - a. Burns
 - b. Hiawatha

2.15 THRESHOLDS, SEALS, DOOR SWEEPS, AUTOMATIC DOOR BOTTOMS, AND GASKETING

- A. Requirements:
 - 1. Provide thresholds, weatherstripping (including door sweeps, seals, and astragals) and gasketing systems (including smoke, sound, and light) as specified and per architectural details. Match finish of other items.
 - 2. Size of thresholds:
 - a. Saddle Thresholds: 1/2 inch (13 mm) high by jamb width by door width
 - b. Bumper Seal Thresholds: 1/2 inch (13 mm) high by 5 inches (127 mm) wide by door width
 - 3. Provide door sweeps, seals, astragals, and auto door bottoms only of type where resilient or flexible seal strip is easily replaceable and readily available.

- B. Manufacturers:
 - 1. Scheduled Manufacturer:
 - a. National Guard Products
 - 2. Acceptable Manufacturers:
 - a. Reese
 - b. Zero

2.16 SILENCERS

- A. Requirements:
 - 1. Provide "push-in" type silencers for hollow metal frames.
 - 2. Provide one silencer per 30 inches (762 mm) of height on each single frame, and two for each pair frame.
 - 3. Omit where gasketing is specified.

- B. Manufacturers:
 - 1. Scheduled Manufacturer:
 - a. Ives
 - 2. Acceptable Manufacturers:
 - a. Burns
 - b. Hiawatha

2.17 FINISHES

- A. Finish: BHMA 630 (US32D); except:
 - 1. Door Closers: Powder Coat to Match

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Prior to installation of hardware, examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance.
- B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Where on-site modification of doors and frames is required:
 - 1. Remove existing hardware being replaced, tag, and store according to contract documents.
 - 2. Field modify and prepare existing door and frame for new hardware being installed.
 - 3. When modifications are exposed to view, use concealed fasteners, when possible.
 - 4. Prepare hardware locations in accordance with:
 - a. Steel Doors and Frames: For surface applied door hardware, drill and tap doors and frames according to ANSI/SDI A250.6.
 - b. Doors in rated assemblies: NFPA 80 for restrictions on on-site door hardware preparation.

3.3 INSTALLATION

- A. Mounting Heights: Mount door hardware units at heights to comply with the following, unless otherwise indicated or required to comply with governing regulations.

1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
 2. Custom Steel Doors and Frames: HMMA 831.
- B. Install each hardware item in compliance with manufacturer's instructions and recommendations, using only fasteners provided by manufacturer.
- C. Do not install surface mounted items until finishes have been completed on substrate. Protect all installed hardware during painting.
- D. Set units level, plumb and true to line and location. Adjust and reinforce attachment substrate as necessary for proper installation and operation.
- E. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
- F. Install operating parts so they move freely and smoothly without binding, sticking, or excessive clearance.
- G. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than quantity recommended by manufacturer for application indicated or one hinge for every 30 inches (750 mm) of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.
- H. Intermediate Offset Pivots: Where offset pivots are indicated, provide intermediate offset pivots in quantities indicated in door hardware schedule but not fewer than one intermediate offset pivot per door and one additional intermediate offset pivot for every 30 inches (750 mm) of door height greater than 90 inches (2286 mm).
- I. Lock Cylinders: Install construction cores to secure building and areas during construction period.
1. Replace construction cores with permanent cores as indicated in keying section.
- J. Key Control System: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.
1. Coordinate location with Engineer.
- K. Door Closers: Mount closers on room side of corridor doors, inside of exterior doors, and stair side of stairway doors from corridors. Closers shall not be visible in corridors, lobbies and other public spaces unless approved by Architect.
- L. Thresholds: Set thresholds in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."

- M. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they may impede traffic or present tripping hazard.
- N. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.
- O. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.
- P. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

3.4 FIELD QUALITY CONTROL

- A. Architectural Hardware Consultant: Engage qualified independent Architectural Hardware Consultant to perform inspections and to prepare inspection reports.
 - 1. Architectural Hardware Consultant will inspect door hardware and state in each report whether installed work complies with or deviates from requirements, including whether door hardware is properly installed and adjusted.
 - 2. Architectural Hardware Consultant will have each Door Hardware Manufacturer's representative inspect their Hardware for compliance of the recommended installation and adjustment standards. This is to include but not limited to Exit Devices, Door Closers and Locksets. Each manufacture is to furnish a letter of certification.

3.5 ADJUSTING

- A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.
 - 1. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.
- B. Occupancy Adjustment: Approximately six (6) months after date of Substantial Completion, Installer's Architectural Hardware Consultant shall examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors, door hardware, and electrified door hardware.

3.6 CLEANING AND PROTECTION

- A. Clean adjacent surfaces soiled by door hardware installation.
- B. Clean operating items as necessary to restore proper function and finish.

- C. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of Substantial Completion.

3.7 DEMONSTRATION

- A. Provide training for Owner's maintenance personnel to adjust, operate, and maintain door hardware and door hardware finishes. Refer to Division 1 Section "Demonstration and Training."

3.8 DOOR HARDWARE SCHEDULE

Door Hardware, General:

1. All exterior doors to have electric locks with associated power supply and panic device override.
2. Single entry door to have panic device and electric lock.
3. Paired side service doors (2/2) with crane rail to have electric lock.
4. Provide sweeps and weatherstripping at all exterior doors.
5. Provide stainless steel drip cap at all exterior doors.

HD-1 Entrance Lever Set (single) (exterior)

1 1/2 butts

Entrance Function lever/lockset (electric lock); coordinate with electric entry key plan.

Butyl weather stripping all around

Bottom sweep

Mop plate interior side only

Heavy duty threshold with gasket

Overhead closer

Silencers

Drip cap

HD Stainless Steel Threshold

HD-2A Multi- Set Lower Doors (pair) (exterior)

3 butts

Bulb weather stripping all around

Store room function lever set on active leaf

Dummy lever set on inactive leaf

Bottom surface flush bolts on inactive leaf

Top surface flush bolts on inactive leaf with long throw

Kick plate both sides

Astragal

Silencers

HD Stainless Steel Threshold

Pair of Wall stops with hook and eye bolted to Bollard; See plan

HD-2B Multi- Set Upper Doors (pair) (exterior)

Overhead door holder (pair)

Pair has no lever set

3 butts

Bulb weather stripping all around

Bottom surface flush bolts on both leafs

Pair of wall stops with hook and eye

Astragal

Brush weatherstripping around beam opening

See door detail sheets for neoprene gasket info

Silencers

Drip cap

Drip base at bottom of doors

HD-2AS Screens for Multi- Set Lower Doors

Interior in-swing lockable mesh screen with bird and insect screen

- Butts - 180 degree swing
- Key Lockset with thumbturn on interior
- Hook and Eye / wall stop hold open

HD-1AS Screen for Entrance Door

Interior in-swing lockable mesh screen with bird and insect screen

- Butts
- Key Lockset with thumbturn on interior
- Hook and Eye / wall stop hold open to railing

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 08800

GLAZING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes glazing for the following products and applications specified in other Sections where glazing requirements are specified by reference to this Section:
 - 1. Aluminum frames.
- B. Related Sections include the following:
 - 1. Division 8 Section "Aluminum Windows."

1.03 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - 2. Review temporary protection requirements for glazing during and after installation.

1.04 DEFINITIONS

- A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.
- B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C1036.
- C. Interspace: Space between lites of an insulating-glass unit.

1.05 PERFORMANCE REQUIREMENTS

- A. General: Provide glazing systems capable of withstanding normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, and installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

- B. Glass Design: Glass thickness designations indicated are minimums and are for detailing only. Confirm glass thicknesses by analyzing Project loads and in-service conditions. Provide glass lites in the thickness designations indicated for various size openings, but not less than thicknesses and in strengths (annealed or heat treated) required to meet or exceed the following criteria:
 - 1. Glass Thicknesses: Select minimum glass thicknesses to comply with ASTM E 1300, according to the following requirements:
 - a. Specified Design Wind Loads: As indicated, but not less than wind loads applicable to Project as required by ASCE 7 "Minimum Design Loads for Buildings and Other Structures": Section 6.0 "Wind Loads", and the Massachusetts State Building Code.
 - 1) Basic Wind Speed: 120 mph.
 - 2) Risk Category: IV.
 - 3) Exposure Category: B.
 - b. Probability of Breakage for Vertical Glazing: 8 lites per 1000 for lites set vertically or not more than 15 degrees off vertical and under wind action.
 - 1) Load Duration: 3 seconds or less.
 - c. Thickness of Tinted and Heat-Absorbing Glass: Provide the same thickness for each tint color indicated throughout Project.

- C. Thermal Movements: Provide glazing that allows for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures acting on glass framing members and glazing components. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

- D. Thermal and Optical Performance Properties: Provide glass with performance properties specified based on manufacturer's published test data, as determined according to procedures indicated below:

1. Center-of-Glass Values: Based on using LBL-35298 WINDOW 5.2 computer program for the following methodologies:
 - a. U-Factors: NFRC 100 expressed as Btu/ sq. ft. x h x deg F.
 - b. Solar Heat Gain Coefficient: NFRC 200.
 - c. Solar Optical Properties: NFRC 300.
2. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.

1.06 PRECONSTRUCTION TESTING

- A. Preconstruction Adhesion and Compatibility Testing: Submit to elastomeric glazing sealant manufacturers, for testing indicated below, samples of each glazing material type, tape sealant, gasket, glazing accessory, and glass-framing member that will contact or affect elastomeric glazing sealants:
 1. Use ASTM C 1087 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of glazing sealants to glass, tape sealants, gaskets, and glazing channel substrates.
 2. Submit not fewer than eight pieces of each type of material, including joint substrates, shims, joint-sealant backings, secondary seals, and miscellaneous materials.
 3. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
 4. For materials failing tests, obtain sealant manufacturer's written instructions for corrective measures, including the use of specially formulated primers.
 5. Testing will not be required if elastomeric glazing sealant manufacturers submit data based on previous testing of current sealant products for adhesion to, and compatibility with, glazing materials matching those submitted.

1.07 ACTION SUBMITTALS

- A. Product Data: For each glass product and glazing material indicated.
- B. Samples: For the following products, in the form of 12-inch- square Samples for glass.
 1. Insulating glass for each designation indicated.
- C. Glazing Schedule: Use same designations indicated on Drawings for glazed openings in preparing a schedule listing glass types and thicknesses for each size opening and location.

- D. Product Certificates: Signed by manufacturers of glass and glazing products certifying that products furnished comply with requirements.
 - 1. For solar-control low-e-coated glass, provide documentation demonstrating that manufacturer of coated glass is certified by coating manufacturer.

1.08 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For installers.
- B. Preconstruction Adhesion and Compatibility Test Report: From glazing sealant manufacturer indicating glazing sealants were tested for adhesion to glass and glazing channel substrates and for compatibility with glass and other glazing materials.
- C. Product Test Reports: For each of the following types of glazing products:
 - 1. Coated float glass.
 - 2. Insulating glass.
 - 3. Glazing sealants.
- D. Warranties: Special warranties specified in this Section.

1.09 QUALITY ASSURANCE

- A. Manufacturer Qualifications for Insulating-Glass Units with Sputter-Coated, Low-E Coatings: A qualified insulating-glass manufacturer who is approved and certified by coated-glass manufacturer.
- B. Installer Qualifications: An experienced installer who has completed glazing similar in material, design, and extent to that indicated for this Project; whose work has resulted in glass installations with a record of successful in-service performance; and who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.
- C. Source Limitations for Glass: Obtain each type of glass through one source from a single manufacturer.
- D. Source Limitations for Glass Sputter-Coated with Solar-Control Low-E Coatings: Where solar-control low-e coatings of a primary glass manufacturer that has established Certified fabricator program is specified, obtain sputter-coated solar-control low-e-coated glass in fabricated units from a manufacturer that is certified by coated-glass manufacturer.
- E. Source Limitations for Glazing Accessories: Obtain glazing accessories through one source from a single manufacturer for each product and installation method indicated.

- F. Glass Product Testing: Obtain glass test results for product test reports in "Submittals" Article from a qualified testing agency based on testing glass products.
 - 1. Glass Testing Agency Qualifications: An independent testing agency with the experience and capability to conduct the testing indicated, as documented according to ASTM E 548.

- G. Elastomeric Glazing Sealant Product Testing: Obtain sealant test results for product test reports in "Submittals" Article from a qualified testing agency based on testing current sealant formulations within a 36-month period.
 - 1. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated, as documented according to ASTM E 548.
 - 2. Test elastomeric glazing sealants for compliance with requirements specified by reference to ASTM C 920, and where applicable, to other standard test methods.

- H. Safety Glazing Products: Comply with testing requirements in 16 CFR 1201.
 - 1. Subject to compliance with requirements, obtain safety glazing products permanently marked with certification label of the Safety Glazing Certification Council or another certification agency acceptable to authorities having jurisdiction.
 - 2. Where glazing units, including Kind FT glass and laminated glass, are specified in Part 2 articles for glazing lites more than 9 sq. ft. in exposed surface area of one side, provide glazing products that comply with Category II materials, for lites 9 sq. ft. or less in exposed surface area of one side, provide glazing products that comply with Category I or II materials, except for hazardous locations where Category II materials are required by 16 CFR 1201 and regulations of authorities having jurisdiction.

- I. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.
 - 1. IGMA Publication for Insulating Glass: SIGMA TM-3000, "Glazing Guidelines for Sealed Insulating Glass Units."

- J. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of the following testing and inspecting agency:
 - 1. Insulating Glass Certification Council.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Protect glazing materials according to manufacturer's written instructions and as needed to prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.
- B. For insulating-glass units that will be exposed to substantial altitude changes, comply with insulating-glass manufacturer's written recommendations for venting and sealing to avoid hermetic seal ruptures.

1.11 PROJECT CONDITIONS

- A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.
 - 1. Do not install liquid glazing sealants when ambient and substrate temperature conditions are outside limits permitted by glazing sealant manufacturer or below 40 deg F.

1.12 WARRANTY

- A. Manufacturer's Special Warranty on Insulating Glass: Manufacturer's standard form in which insulating-glass manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.
 - 1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 GLASS PRODUCTS

- A. Fully Tempered Float Glass: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.
 - 1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.

- B. Sputter-Coated Float Glass: ASTM C 1376, float glass with metallic-oxide or -nitride coating deposited by vacuum deposition process after manufacture and heat treatment (if any), and complying with other requirements specified.

2.02 INSULATING GLASS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide **Vitro Architectural Glass; Solarban 70** or comparable product by one of the following:
 - 1. Guardian Industries Corp.
 - 2. Viracon, Inc.
- B. Insulating-Glass Units, General: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, and complying with ASTM E 774 for Class CBA units and with requirements specified in this Article and in Part 2 "Insulating-Glass Units" Article.
 - 1. Overall Unit Thickness and Thickness of Each Lite: Dimensions indicated for insulating-glass units are nominal and the overall thicknesses of units are measured perpendicularly from outer surfaces of glass lites at unit's edge.
 - 2. Sealing System: Dual seal, with primary and secondary sealants as follows:
 - a. Polyisobutylene and silicone.
 - 3. Spacer Specifications: Manufacturer's standard spacer material and construction complying with the following requirements:
 - a. Spacer Material: Aluminum with mill or clear anodic finish.
 - b. Desiccant: Molecular sieve or silica gel, or blend of both.
 - c. Corner Construction: Manufacturer's standard corner construction.

2.03 GLAZING SEALANTS

- A. General: Provide products of type indicated, complying with the following requirements:
 - 1. Compatibility: Select glazing sealants that are compatible with one another and with other materials they will contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
 - 2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
 - 3. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range.

- B. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 50, Use NT.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dow Corning Corporation; 795.
 - b. GE Advanced Materials - Silicones; SilPruf SCS2000.
 - c. Pecora Corporation; 895.
 - d. Tremco Incorporated; Spectrem 2.
 2. Type and Grade: S (single component) and NS (nonsag).
 3. Class: 50.
 4. Use Related to Exposure: NT (nontraffic).
 5. Uses Related to Glazing Substrates: M, G, A, and, as applicable to glazing substrates indicated, O.
 - a. Use O Glazing Substrates: Coated glass and aluminum coated with a high-performance coating.

2.04 GLAZING TAPES

- A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based elastomeric tape with a solids content of 100 percent; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; packaged on rolls with a release paper backing; and complying with ASTM C 1281 and AAMA 800 for products indicated below:
1. AAMA 804.3 tape, where indicated.
 2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
 3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.
- B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; packaged on rolls with release liner protecting adhesive; and complying with AAMA 800 for the following types:
1. Type 1, for glazing applications in which tape acts as the primary sealant.
 2. Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.05 MISCELLANEOUS GLAZING MATERIALS

- A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.
- B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
- D. Spacers: Elastomeric blocks or continuous extrusions with a Shore, Type A durometer hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
- E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).
- F. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

2.06 FABRICATION OF GLAZING UNITS

- A. Fabricate glazing units in sizes required to glaze openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.
- B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites in a manner that produces square edges with slight kerfs at junctions with outdoor and indoor faces.
- C. Grind smooth and polish exposed glass edges and corners.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine framing glazing, with Installer present, for compliance with the following:
 - 1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
 - 2. Presence and functioning of weep system.
 - 3. Minimum required face or edge clearances.
 - 4. Effective sealing between joints of glass-framing members.

- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

3.03 GLAZING, GENERAL

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Glazing channel dimensions provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances. Adjust as required by Project conditions during installation.
- C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.
- D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction sealant-substrate testing.
- E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- G. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.
- H. Provide spacers for glass lites where length plus width is larger than 50 inches as follows:
 - 1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
 - 2. Provide 1/8-inch minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.

- I. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

3.04 TAPE GLAZING

- A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.
- B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.
- C. Cover vertical framing joints by applying tapes to heads and sills first and then to jambs. Cover horizontal framing joints by applying tapes to jambs and then to heads and sills.
- D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
- E. Do not remove release paper from tape until just before each glazing unit is installed.
- F. Apply heel bead of elastomeric sealant.
- G. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.
- H. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.05 SEALANT GLAZING (WET)

- A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.
- B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.
- C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.06 CLEANING AND PROTECTION

- A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels, and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations, including weld splatter. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended by glass manufacturer.
- C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains; remove as recommended in writing by glass manufacturer.
- D. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.
- E. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

3.07 INSULATING-GLASS UNITS

- A. **Glass Type:** Low-E Insulating-Glass Units.
 - 1. Overall Unit Thickness: 1-inch.
 - 2. Thickness of Each Glass Lite: 6.0 mm.
 - 3. Interspace Content: Argon.
 - 4. Outdoor Lite: Clear fully tempered float glass.
 - 5. Indoor Lite: Clear fully tempered float glass.
 - 6. Low-E Coating: Sputtered on second surface.
 - 7. Visible Light Transmittance: 68 percent minimum.
 - 8. Winter Nighttime U-Factor: 0.24 maximum.
 - 9. Solar Heat Gain Coefficient: 0.23 maximum.
 - 10. Outdoor Visible Reflectance: 11 percent maximum.
 - 11. Provide safety glazing labeling.

END OF SECTION

DIVISION 09

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 09882

EPOXY LINING SYSTEM

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Requirements for work, materials, equipment, tools, and application equipment for installation and testing of a monolithic lining system.
2. Requirements for specialized application equipment and rigorous surface preparation requirements used to apply the surfacing system without the use of solvents.
3. Product application requirements and procedures, including surface preparation, mixing, application, material handling and storage, qualification of Application Contractor and application quality control.

B. Related Sections:

1. Section 02149 - Maintaining Existing Flow
2. Section 03930 – Concrete Rehabilitation
3. Section 03940 – Concrete Crack Repairs by Epoxy Injection.

1.02 REFERENCES

A. American Society for Testing and Materials (ASTM)

1. D543 - Standard Practices for Evaluating the Resistance of Plastics to Chemical Reagents.
2. D638 - Standard Test Method for Tensile Properties of Plastics.
3. D695 - Standard Test Method for Compressive Properties of Rigid Plastics.
4. D790 - Standard Test Method for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
5. D2240 - Standard Test Method for Rubber Property - Durometer Hardness, Type D.
6. D2584 - Standard Test Method for Ignition Loss of Cured Reinforced Resins.
7. D4414 - Standard Practice for Measurement of Wet Film Thickness by Notch Gages
8. D4541 - Standard Test Method for Pull-off Strength of Coatings Using a Portable Adhesion Tester.

B. NACE - The published standards of National Association of Corrosion Engineers (NACE International), Houston, TX.

1.03 SUBMITTALS

A. In accordance with Section 01300, submit the following:

1. Product data and manufacturer's application instructions.
2. Samples
 - a. Colors as required.
3. Quality Assurance Submittal:
 - a. Submit documentation stating the Application Contractor is an approved installer and licensed by the epoxy system manufacturer and specialized equipment supplier.
 - b. Submit documentation stating the Application Contractor's experience, listing at least 5 past clients to verify previous satisfactory performance on projects of similar or greater size and difficulty factor. Submitted documentation shall include the project type, total value of the contract, date of project completion, as well as Owner and Engineer contact information, including names, addresses, and telephone numbers.
 - c. Submit documentation from the monolithic surfacing manufacturer listing at least 5 previous installations of the product including installation dates, description of work performed, contact names and telephone numbers.

1.04 QUALITY ASSURANCE

- A. Application Contractor must be established in the epoxy lining industry, have at least 5 years of experience in the epoxy lining of structures, and have coated a minimum of 6,000 structures. The Application Contractor cannot share the experience of the manufacturer.
- B. Application Contractor shall initiate and enforce quality control procedures consistent with applicable ASTM and NACE standards together with pull testing and vacuum testing to assure a high quality project.
- C. Application Contractor shall use an adequate number of skilled workmen who are thoroughly trained and experienced in the necessary crafts. These workmen shall be completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section. The supervisor and foreman must have a minimum of 5 years experience in epoxy restoration via plural component spray application with 100% solid epoxy.
- D. Application Contractor shall use approved specialty equipment adequate in size, capacity and number sufficient to accomplish the work of this Section in a timely manner.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Packing, Shipping, Handling, and Unloading
 1. In accordance with manufacturer's recommendations.
 2. Protective coating materials are to be handled according to their material safety data sheets.
- 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. Materials are to be kept dry, protected from weather, stored under cover, and stored between 50 deg F and 90 deg F. Do not store near flame, heat or strong oxidants.

PART 2 PRODUCTS

2.01 MANUFACTURERS AND EQUIPMENT SUPPLIERS

- A. Epoxy lining materials and appropriate application equipment shall be by Warren Environmental, Inc., Carver, MA or approved equal.

2.02 REPAIR MATERIALS

- A. Repair materials must be accepted and approved by the specifying engineer and must be compatible with the specified epoxy system. No cementitious repair materials will be allowed. Only 100% solids epoxy mastic repair materials shall be used to profile or build out deteriorated walls.

2.03 STRUCTURAL EPOXY LINING AND REPAIR SYSTEM

- A. A non-toxic, 100% solids, solventless epoxy resin system as applied according to the manufacturer's requirements, and a non-toxic, 100% solids epoxy mastic repair resin system applied by hand and/or trowel, exhibiting the following characteristics:

Product	Structural Epoxy
Product type	cycloaliphatic cured novalac-epoxy resin
Color	White (resin coating) / Light Grey (mastic)
Solids Content (vol %)	100%
Compressive Strength	ASTM D695 11,000 p.s.i.
Flatwise Tensile Strength	
Of Sandwich Constructions	ASTM C297 2,608 p.s.i.
Tensile Strength	ASTM D638 6,000 p.s.i.
Tensile Elongation	ASTM D638 4%
Flexural Strength	ASTM D790 11,000 p.s.i.
Flexural Modulus	ASTM D790 500,000 p.s.i.
Bond Strength – Concrete	ASTM D4541 Concrete Failure
Chemical Resistance to:	
Sulfuric Acid, 70%	ASTM D543 Immersion Service
Sodium Hydroxide, 20%	ASTM D543 Immersion Service

- B. The monolithic lining system shall be continuously bonded to all brick, mortar, concrete, chemical sealant, grout, pipe and other surfaces inside the structure

according to ASTM D4541. Coating thickness shall be designed for application intended as indicated on the Drawings

- C. The cured epoxy will be monolithic with proper sealing to all internal connections and shall be placed and cured in 1 or 2 applications in conformance with the recommendations of the structural epoxy system manufacturer. Recommended thickness of the applied epoxy can vary due to substrate conditions and will be applied per the recommendations of the coating manufacturer as approved by the Engineer.
- D. When cured, the system shall form a continuous, tight-fitting, hard, impermeable surfacing that is suitable for sewer system service and chemically resistant to any chemicals, bacteria or vapors normally found in domestic or industrial sewage
- E. The system shall effectively seal the interior surfaces of the structure and prevent any penetration or leakage of groundwater (infiltration).
- F. The system shall be compatible with the thermal conditions of the existing sewer structure.

2.04 STRUCTURAL EPOXY APPLICATION EQUIPMENT

- A. Heated, plural component, specially designed equipment for use in the spray or spincast application of the specified system approved for use and as designed and developed by the structural epoxy manufacturer. The product may also be hand troweled as directed per manufacturers instructions.

PART 3 EXECUTION

3.01 PRE-COAT INSPECTION

- A. All structures to be coated shall be readily accessible to the Application Contractor.
- B. Appropriate actions shall be taken to comply with local, state and federal regulatory and other applicable agencies with regard to environment, health and safety.
- C. Active flows shall be diverted with flow through plugs or bypass pumped, in accordance with Section 02149 of the Specifications, as required to ensure that the liquid flow is maintained off the surfaces to be lined.
- D. Installation of the protective coating shall not commence until the concrete substrate has properly cured a minimum cure of 28 days for new concrete.

3.02 SURFACE PREPARATION

- A. Application Contractor shall inspect all surfaces specified to receive the monolithic surfacing system prior to surface preparation. Application Contractor shall notify

- Engineer of any noticeable disparity in the surfaces that may interfere with the proper preparation or application of the monolithic surfacing system.
- B. All concrete that is not sound or has been damaged by chemical exposure shall be removed to a sound concrete surface. All contaminants including: oils, grease, incompatible existing coatings, waxes, form release, curing compounds, efflorescence, sealers, salts, or other contaminants must be removed.
 - C. Surface preparation method(s) shall be based upon the conditions of the substrate and the requirements of the monolithic surfacing system to be applied.
 - D. Quick setting high strength concrete with latex or curing agent additives cannot be used to re-profile the surface to be epoxy lined. Proper surface preparation procedures must be followed to ensure adequate bond strength to any surface to be coated. New cement must cure at least 30 days prior to coating.
 - E. Existing coatings should be removed or thoroughly abraded to provide adequate surface profile for mechanical bond by the new system. Application Contractor is to maintain strict adherence to the monolithic surfacing system manufacturer's recommendations with regard to proper surface preparation and compatibility with restoration and structural liner materials.
 - F. Surfaces to receive protective coating shall be cleaned and abraded to produce a sound surface with adequate profile and porosity to provide a strong bond between the epoxy surfacing system and the substrate. The first procedure upon entering each structure will be to blast all specified surfaces by low pressure water cleaning. When all loose and /or contaminated debris has been removed, the surface shall be water blasted by the use of a hand held wand again. The wash water shall include a dilute solution of chlorine to diminish bacterial growth and to kill any bacteria residing on or in the surface. The surface will be tested at this point to ensure that the pH is within acceptable limits (not to exceed 8.5). These tests will be performed with litmus paper on various areas within the structure.
 - G. Surfaces that require additional cleaning or profiling will be prepared by abrasive blast or water blasting at 4,000 to 10,000 psi in order to rough the surface sufficient to obtain and ensure adequate bonding of the system. A minimum surface profile of 8-10 mils must be achieved to assure proper adhesion. Detergent water cleaning and hot water blasting may be necessary to remove oils and grease from the concrete or brick. Whichever methods are used, they shall be performed in a manner that provides a uniform, sound clean surface that is not excessively damaged.
 - H. All active water infiltration shall be stopped by using approved cementitious water plug or hydroactive grout prior to application of the epoxy coating system. The water plug or grout shall be compatible and suitable for topcoating with the specified epoxy surfacing system. Latex base products cannot be used, - NO exception.
 - I. All surfaces shall be inspected during and after preparation and prior to application of the monolithic surfacing system. Any evidence of remaining contamination or

residuals shall be removed by additional water or abrasive blast, or other approved method before proceeding with application of the monolithic surfacing system.

3.03 APPLICATION OF REPAIR MATERIALS

- A. The surface shall be dried in accordance with the manufacturer's requirements prior to application of the epoxy coating.
- B. Areas where reinforcing steel has been exposed or removed shall be repaired by replacing spent rebar with new rebar to match existing. All new rebar will be embedded in 1 ½ inch of epoxy mastic.
- C. Repair materials shall meet the specifications of this Section. The materials shall be trowel or spray applied utilizing proper equipment on to specified surfaces. The material thickness shall be specified by the Engineer according to Owner's requirements and manufacturer's recommendations.
- D. All surfaces shall be inspected during and after preparation and prior to application of the monolithic surfacing system. Any evidence of remaining contamination or latence shall be removed by additional water or abrasive blast, or other approved method before proceeding with application of the monolithic surfacing system.
- E. Approved repair materials, shall be trowelled to provide a smooth surface with an average profile equivalent to coarse sandpaper to receive the protective coating. No bugholes or honeycomb surfaces should remain after the final trowel procedure of the repair epoxy mortar.
- F. The repair materials shall be permitted to cure according to manufacturer recommendations. Curing compounds may not be used unless approved by the monolithic surfacing system manufacturer for compatibility with the specified system.
- G. Application procedure of the repair materials, if not performed by the monolithic surfacing system applicator, should be observed by the Applicator's representative to ensure proper finishing for suitability to receive the specified epoxy liner.
- H. All surfaces shall be sufficiently smooth and even, to ensure good flow handling characteristics when coated with epoxy materials.

3.04 STRUCTURAL EPOXY REHABILITATION SYSTEM

- A. Application procedures shall conform to the recommendations of the structural epoxy manufacturer, including material handling, mixing, and environmental controls during application, safety, and equipment.
- B. The equipment shall be specially designed to accurately ratio and apply the specified materials and shall be regularly maintained and in proper working order.
- C. The specified materials must be applied by an approved installer.

- D. All specified surfaces will be lined with the structural epoxy system to provide a minimum total thickness of 250 mils for rehab structures and 125 mils for new concrete. The epoxy liner shall be monolithic with proper sealing of connections to all unsurfaced areas and shall be placed and cured in one to two applications, depending on the existing structure's conditions.

3.05 TESTING AND INSPECTION

- A. A wet film thickness gauge, such as those available through Paul N. Gardner Company, Inc. meeting ASTM D4414, shall be used to ensure a monolithic coating and uniform thickness during application.
- B. After the system has set hard to the touch it shall be inspected by the Engineer verifying the following:
 - 1. The Engineer will measure the system-cured thickness from a specimen retrieved by the Application Contractor. Retrieval can be made by physically cutting through the epoxy liner (by drilling or coring) or a suitable non-destructive type of thickness measurement may also be used, (e.g. ultrasonic).
 - 2. Groundwater infiltration of the system shall be zero.
 - 3. All pipe connections shall be open and clear.
 - 4. No cracks, voids, pinholes, uncured spots, dry spots, lifts, delamination or other type defects shall be evident in the system.
- C. All lined surfaces will be tested with high-voltage holiday detection equipment. The spark tester shall be initially set at 100 volts per 1 mil (25 microns) of film thickness applied but may be adjusted as necessary to detect the pinhole. All detected pinholes shall be marked and repaired by abrading the lined surface with grit disk paper or other hand tooling method. After abrading and cleaning, additional system material can be hand applied to the repair area. All touch-up/repair procedures shall follow the monolithic surfacing system manufacturer's recommendations.
- D. Measurement of bond strength of the system to the substrate can be made at regular intervals and along different sections of the structure (i.e. corbel, wall, and bench). Bond strength can be measured in accordance with ASTM D4541. Any areas detected to have inadequate (less than 300 p.s.i. or 80% substrate failure to concrete) bond strength shall be evaluated by the Engineer. Further bond tests may be performed in that area to determine the extent of potentially deficient bonded area and repairs shall be made by the Application Contractor in strict accordance with the manufacturer's recommendations.
- E. A final visual inspection shall be made by the Engineer and the Application Contractor. Any deficiencies in the finished system shall be marked and repaired according to the procedures set forth herein by the Application Contractor.
- F. The system may be put back into operational service as soon as the final inspection has taken place.

G. After two days cure time, the structures can be vacuum tested and repaired, if necessary, at the contractor's expense.

3.06 CLEANING

A. Trash and loose debris shall not be permitted to accumulate at the project site. All items shall be regularly removed and disposed of at an approved site in accordance with applicable regulatory agencies.

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 09910

PAINTING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes surface preparation and the application of paint systems on the following substrates:
 - 1. Concrete.
 - 2. Concrete masonry units (CMU).
 - 3. Galvanized metal.
 - 4. Hollow metal doors and frames.
 - 5. Exposed piping, conduit, ductwork, etc.
 - 6. Exposed structural framing.
 - 7. Metal stairs, handrails, and guardrails, existing.
 - 8. All other items indicated to be painted on the Drawings and Specifications.
- B. Paint exposed surfaces, except where these Specifications indicate that the surface or material is not to be painted or is to remain natural. If an item or a surface is not specifically mentioned, paint the item or surface the same as similar adjacent materials or surfaces. If a color of finish is not indicated, Architect will select from standard colors and finishes available.
 - 1. Painting includes field painting of exposed bare and covered pipes and ducts, hangers, exposed steel and iron supports, and surfaces of mechanical and electrical equipment that do not have a factory-applied final finish.
- C. Do not paint prefinished items, concealed surfaces, finished metal surfaces, operating parts, and labels.
 - 1. Prefinished items include the following factory-finished components:
 - a. Exterior metal guardrails.
 - b. Toilet enclosures.
 - c. Finished mechanical and electrical equipment.
 - d. Light fixtures and wiring devices.
 - e. Switchgear.

- f. Distribution cabinets in closets or equipment rooms.
- 2. Concealed surfaces include walls or ceilings in the following generally inaccessible spaces:
 - a. Furred areas.
 - b. Ceiling plenums.
 - c. Pipe spaces.
 - d. Duct shafts.
- 3. Finished metal surfaces include the following:
 - a. Anodized or coated aluminum.
 - b. Stainless steel.
 - c. Chromium plate.
 - d. Copper and copper alloys.
 - e. Bronze and brass.
 - f. Prefinished acoustical tile moldings and trim.
 - g. Prefinished metal reveals in gypsum board assemblies.
- 4. Operating parts include moving parts of operating equipment and the following:
 - a. Valve and damper operators.
 - b. Linkages.
 - c. Sensing devices.
 - d. Motor and fan shafts.
- 5. Labels: Do not paint over UL, FMG, or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.

D. Related Sections include the following:

- 1. Division 8 Section "Hollow Metal Doors and Frames" for factory priming steel doors and frames.
- 2. Division 9 Section "High Performance Coatings" for floor coatings.
- 3. Divisions 15 and 16 Sections for painting of mechanical and electrical equipment.

1.03 DEFINITIONS

A. General: Standard coating terms defined in ASTM D 16 apply to this Section.

- 1. Flat refers to a lusterless or matte finish with a gloss range below 15 when measured at an 85-degree meter.
- 2. Eggshell refers to low-sheen finish with a gloss range between 20 and 35 when measured at a 60-degree meter.
- 3. Semigloss refers to medium-sheen finish with a gloss range between 35 and 70 when measured at a 60-degree meter.

4. Full gloss refers to high-sheen finish with a gloss range more than 70 when measured at a 60-degree meter.

1.04 SUBMITTALS

- A. Product Data: For each type of product indicated.
 1. Material List: An inclusive list of required coating materials. Indicate each material and cross-reference specific coating, finish system, and application. Identify each material by manufacturer's catalog number and general classification.
 2. Manufacturer's Information: Manufacturer's technical information, including label analysis and instructions for handling, storing, and applying each coating material.
- B. Samples for Verification: For each type of paint system and in each color and gloss of topcoat indicated.
 1. Submit Samples on rigid backing, 8 inches square.
 2. Step coats on Samples to show each coat required for system.
 3. Label each coat of each Sample.
 4. Label each Sample for location and application area.
- C. Qualification Data: For firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of Architects and Owners, and other information specified.
- D. Product List: For each product indicated, include the following:
 1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
 2. VOC content.

1.05 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For coatings to include in maintenance manuals. Include the following:
 1. Area summary with Finish Schedule and area detail designating where each product, color, and finish is used.
 2. Product data pages.
 3. Material safety data sheets.
 4. Care and cleaning instructions.
 5. Touch-up procedures.
 6. Color samples of each color and finish (gloss level) used.

1.06 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials described below that are from same production run (batch mix) as materials applied and that are packaged for storage and identified with labels describing contents.
 - 1. Quantity: Furnish an additional 1 gallon of each material and color applied.

1.07 QUALITY ASSURANCE

- A. Applicator Qualifications: A firm or individual experienced in applying paints and coatings similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance.
- B. Mockups: Apply benchmark samples of each paint system indicated and each color and finish selected to verify preliminary selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Architect will select one surface to represent surfaces and conditions for application of each paint system specified in Part 3, and a minimum of 7 paint colors.
 - a. Wall Surfaces: Provide samples of at least 100 sq. ft.
 - 2. Apply benchmark samples after permanent lighting and other environmental services have been activated.
 - 3. Final approval of color selections will be based on benchmark samples.
 - a. If preliminary color selections are not approved, apply additional benchmark samples of additional colors selected by Architect at no added cost to Owner.
 - 4. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 5. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.
 - 1. Maintain containers in clean condition, free of foreign materials and residue.
 - 2. Remove rags and waste from storage areas daily.

1.09 PROJECT CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.
- B. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Benjamin Moore & Co., including affiliate brands Coronado and Corotech.
 - 2. PPG Industries Inc. (PPG).
 - 3. Sherwin-Williams Company.

2.02 PAINT, GENERAL

- A. Material Compatibility:
 - 1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 - 2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.
- B. VOC Content for Interior Paints and Coatings:
 - 1. All interior paints and coatings shall comply with the VOC content regulations of the Ozone Transportation Commission (OTC) effective in the Commonwealth of Massachusetts. For interior paints and coatings applied at Project site, the following VOC limits, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - a. Nonflat Coatings: 150 g/L.
 - b. Primers, sealers and undercoaters: 200 g/L.
 - c. Anti-corrosive and Anti-rust Paints Applied to Ferrous Metals: 250 g/L.
 - d. Dry-Fog Coatings: 400 g/L.
- C. Colors: As selected by Architect from manufacturer's full range.

2.03 CONCRETE UNIT MASONRY BLOCK FILLERS

- A. Concrete Unit Masonry Block Filler: Factory-formulated high performance block filler for use with epoxy finish coats (**150 g/L**):
1. Benjamin Moore; Super Spec Masonry Hi-Build Block Filler 206: Applied at a dry film thickness of not less than 8.5 mils.
 2. PPG; 6-15 Speedhide Interior/Exterior Masonry Hi Fill Latex Block Filler: Applied at a dry film thickness of not less than 7.0 mils.
 3. Sherwin-Williams; Loxon Block Surfacer A24W200: Applied at a dry film thickness of not less than 8.0 mils.

2.04 EXTERIOR PRIMERS

- A. Exterior Galvanized Metal Primer: Factory-formulated galvanized metal primer for exterior application.
1. Benjamin Moore; Super Spec HP Acrylic Metal Primer No. P04: Applied at a dry film thickness of not less than 2.0 mils.
 2. PPG; 90-912 Pitt-Tech Interior/Exterior Primer/Finish DTM Industrial Enamel: Applied at a dry film thickness of not less than 3.0 mils.
 3. Sherwin-Williams; Pro Industrial Pro-Cryl Universal Acrylic Primer: Applied at a dry film thickness of not less than 2.0 mils.

2.05 INTERIOR PRIMERS

- A. General: Provide tinted primers as required for dark colors.
- B. Interior Concrete Primer: Factory-formulated alkali-resistant acrylic-latex interior primer for interior application (**100 g/L**).
1. Benjamin Moore; Super Spec Masonry Primer Sealer N066: Applied at a dry film thickness of not less than 0.95 mils.
 2. PPG; 4-2 Perma-Crete High Build 100% Acrylic Primer: Applied at a dry film thickness of not less than 2.6 mils.
 3. Sherwin-Williams; Loxon Concrete & Masonry Primer A24W8300: Applied at a dry film thickness of not less than 3.2 mils.
- C. Interior Metal Primer: Factory-formulated metal primer (**100 g/L**).
1. Benjamin Moore; Super Spec Acrylic Metal Primer No. P04: Applied at a dry film thickness of not less than 1.7 mils.
 2. PPG; 90-912 Series Pitt-Tech Interior/Exterior Primer/Finish DTM Industrial Enamel: Applied at a dry film thickness of not less than 2.0 mils.
 3. Sherwin-Williams; Pro Industrial Pro-Cryl Universal Acrylic Primer B66 Series: Applied at a dry film thickness of not less than 2.0 mils.

2.06 EXTERIOR PAINTS

- A. Exterior Full-Gloss Acrylic Enamel: Factory-formulated full-gloss waterborne acrylic-latex enamel for exterior metal application.
1. Benjamin Moore; Ultra Spec HP DTM Acrylic Gloss Enamel, HP28: Applied at a dry film thickness of not less than 2.3 mils.
 2. PPG; 90-374 Series Pitt-Tech Interior/Exterior High Gloss DTM Industrial Enamels: Applied at a dry film thickness of not less than 3.0 mils.
 3. Sherwin-Williams; Acrylic Coating Gloss (Waterborne) B66 Series: Applied at a dry film thickness of not less than 2.4 mils.

2.07 INTERIOR PAINTS

- A. Interior Semi-Gloss Acrylic Enamel for Metal Surfaces: Factory-formulated semi-gloss acrylic interior enamel (**100 g/L**).
1. Benjamin Moore; Ultra Spec HP DTM Acrylic Semi-Gloss Enamel HP29: Applied at a dry film thickness of not less than 1.5 mils.
 2. PPG; 4216HP Series Pitt-Tech Plus High Performance Waterborne DTM Acrylic Semi-Gloss: Applied at a dry film thickness of not less than 2.0 mils.
 3. Sherwin-Williams; Pro Industrial Acrylic B66 Series Semi-Gloss: Applied at a dry film thickness of not less than 2.5 mils.
- B. Interior Acrylic Enamel (Flat Dryfall): Factory-formulated enamel for overhead interior application ceilings and structural framing (**150 g/L**).
1. Coronado Paint; Super Kote 5000 Latex Flat Dry Fall 110 Line: Applied at a dry film thickness of not less than 1.5 mils.
 2. PPG; SpeedHide Super Tech WB Interior Dry-Fog Flat Latex 6-725XI: Applied at a dry film thickness of not less than 2.2 mils.
 3. Sherwin-Williams; Low VOC Waterborne Acrylic Dryfall Flat B42W00081: Applied at a dry film thickness of not less than 1.7 mils.

2.08 EPOXY COATINGS

- A. Epoxy Low Luster Coating for Concrete and Masonry Vertical Surfaces (**150 g/L**)
1. Corotech; V342 Pre-Catalyzed Waterborne Epoxy Eggshell, applied at a dry film thickness of not less than 1.5 mils.
 2. PPG; 16-310 Series Pitt-Glaze WB1 Interior Eggshell Pre-Catalyzed Water-Borne Acrylic Epoxy: Applied at a dry film thickness of not less than 1.5 mils.
 3. Sherwin-Williams; Pro Industrial Water Based Catalyzed Epoxy B73-360 Series: Applied at a dry film thickness of not less than 2.0 mils (50 g/L).

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 - 1. Concrete: 12 percent.
 - 2. Masonry (Clay and CMU): 12 percent.
 - 3. Gypsum Board: 12 percent.
- C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- D. Coordination of Work: Review other Sections in which primers are provided to ensure compatibility of the total system for various substrates. On request, furnish information on characteristics of finish materials to ensure use of compatible primers.
 - 1. Notify Architect about anticipated problems when using the materials specified over substrates primed by others.
- E. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.
 - 1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

3.02 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates indicated.
- B. Remove plates, machined surfaces, and similar items already in place that are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
 - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
 - 2. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.

- C. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease, and incompatible paints and encapsulants.
 - 1. Remove incompatible primers and reprime substrate with compatible primers as required to produce paint systems indicated.
- D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
- E. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceed that permitted in manufacturer's written instructions.
 - 1. Apply block filler with a roller and backroll prior to application of finish coats.
- F. Steel Substrates: Remove rust and loose mill scale. Clean using methods recommended in writing by paint manufacturer.
- G. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.
- H. Gypsum Board Substrates: Do not begin paint application until finishing compound is dry and sanded smooth.

3.03 APPLICATION

- A. Apply paints according to manufacturer's written instructions.
 - 1. Use applicators and techniques suited for paint and substrate indicated.
 - 2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 - 3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
- B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

- E. Painting Mechanical, Fire Protection, Plumbing and Electrical Work: Paint items exposed in equipment rooms and occupied spaces including, but not limited to, the following:
 - 1. Mechanical, Fire Protection and Plumbing Work:
 - a. Uninsulated metal piping.
 - b. Uninsulated plastic piping.
 - c. Pipe hangers and supports.
 - d. Mechanical equipment that is indicated to have a factory-primed finish for field painting.
 - e. Piping that is indicated to have a factory-primed finish for field painting.
 - 2. Electrical Work:
 - a. Switchgear.
 - b. Panelboards.
 - c. Electrical equipment that is indicated to have a factory-primed finish for field painting.

3.04 SCHEDULE OF COLOR SYSTEM MATERIAL IDENTIFICATION

- A. Colors reflect the guidelines of Technical Report #16 (TR-16) prepared by the New England Interstate Water Pollution Control Commission, and the Recommended Standards for Wastewater Facilities prepared by the Great Lakes – Upper Mississippi River Board of State and Provincial Public Health and Environmental Managers (10 States’ Standards).

COLOR CODING SCHEDULE

Service	Generic Color	Color Identification
Non-Potable Water	Purple	SW-6838 Vigorous Violet
Wastewater	light gray	IN01 Light Gray
Drains	black	IN06 Black

- B. Sample, drain, overflow, vent, metering, blowoff and other associated lines shall be painted the same code color as the piping system they serve.
- C. Existing surfaces, items of existing equipment, and piping which will require refinishing as a result of demolition and alteration work shall be repainted using the appropriate paint. Repainting shall not be limited to spot touch-up but shall include the painting of entire surfaces where demolition or alteration work has taken place.

- D. Insulated pipe jacketed with aluminum or stainless steel shall not be painted, but uninsulated valves and fittings on such lines shall be color coded in accordance with color coding schedule. Such piping shall be identified by bands of proper code color and by legend.
- E. Plumbing and HVAC lines, and electrical and telecommunications conduit exposed in finished areas, shall not be color coded but shall be painted the same color as the background to which they are adjacent, or as approved by engineer.
- F. Items of equipment connected to color coded systems shall be painted the same color as the system they serve.

3.05 PIPE IDENTIFICATION

- A. Label piping by contents and arrows indicating direction of flow.
- B. Labels to be twenty feet (20) apart maximum, and within each space through which pipeline passes.
- C. Adjacent to each side of walls which pipeline penetrate.
- D. Adjacent to valves, equipment, and pumps.
- E. Locate labels where they are unobstructed from view and visible from valves.
- F. Colors to be white or black as appropriate for the substrate.
- G. Letters, numbers and flow arrows to be stenciled to pipeline and equipment or die cut from vinyl film as approved by the Engineer.
- H. 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
- I. 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.

3.06 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

3.07 EXTERIOR PAINT SCHEDULE

- A. Zinc-Coated Metal: Provide the following finish systems over exterior zinc-coated metal surfaces, including hollow metal doors and frames:
 - 1. Full-Gloss Acrylic-Enamel Finish: Two finish coats over galvanized metal.
 - a. Primer: Metal primer, including factory primed surfaces.
 - b. Finish Coats: Exterior full-gloss acrylic enamel.

3.08 INTERIOR PAINTING SCHEDULE

- A. Concrete: Provide the following finish systems over interior concrete:
 - 1. Low-Luster Epoxy Finish: Two finish coats over a primer.
 - a. Primer: Interior concrete primer.
 - b. Finish Coats: Epoxy low-luster finish.
- B. Concrete Unit Masonry: Provide the following finish systems over interior concrete masonry:
 - 1. Low-Luster Epoxy Finish: Two finish coats over a filled surface.
 - a. Block Filler: Concrete unit masonry block filler for epoxy finish
 - b. Finish Coats: Epoxy low-luster finish.
- C. Ferrous and Zinc-Coated Metal: Provide the following finish systems over all ferrous metal:
 - 1. Full-Gloss Acrylic-Enamel Finish: Two finish coats over a metal primer.
 - a. Primer: Metal primer, including surfaces with factory prime coat.
 - b. Finish Coats: Interior full-gloss acrylic enamel for metal surfaces.

- D. Exposed Structure: Provide the following finish system over exposed metal roof deck and steel structure, including all ductwork and all piping:
1. Flat Dryfall Acrylic-Enamel Finish: One finish coat.
 - a. Primer: None required for DTM products.
 - b. Finish Coats: Interior acrylic dryfall for metal surfaces.

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 09960

HIGH-PERFORMANCE COATINGS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes surface preparation and application of high-performance coating systems on the following substrates:
 - 1. Interior Substrates:
 - a. Concrete slabs.
 - b. Concrete and CMU walls.
- B. Related Sections include the following:
 - 1. Division 9 Section "Painting" for general field painting.

1.03 SUBMITTALS

- A. Product Data: For each type of product indicated.
 - 1. Material List: An inclusive list of required coating materials. Indicate each material and cross-reference specific coating, finish system, and application. Identify each material by manufacturer's catalog number and general classification.
 - 2. Manufacturer's Information: Manufacturer's technical information, including label analysis and instructions for handling, storing, and applying each coating material.
- B. Samples for Initial Selection: For each type of finish-coat product indicated.
- C. Samples for Verification: For each type of coating system and in each color and gloss of finish coat indicated.
 - 1. Submit Samples on rigid backing, 8 inches square.
 - 2. Step coats on Samples to show each coat required for system.
 - 3. Label each coat of each Sample.
 - 4. Label each Sample for location and application area.

- D. Product List: For each product indicated. Cross-reference products to coating system and locations of application areas. Use same designations indicated on Drawings and in schedules.

1.04 QUALITY ASSURANCE

- A. Preconstruction Testing Service for Existing Concrete: Engage a qualified independent testing agency to perform moisture vapor emission testing indicated below.
 - 1. ASTM F 1869, Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.
 - 2. ASTM F 2170, Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in Situ Probes.
- B. Mockups: Apply benchmark samples of each coating system indicated to verify preliminary selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Architect will select one surface to represent surfaces and conditions for application of each type of coating and substrate.
 - a. Floor Surfaces: Provide samples of at least 100 sq. ft.
 - 2. Apply benchmark samples after permanent lighting and other environmental services have been activated.
 - 3. Final approval of color selections will be based on benchmark samples.
 - a. If preliminary color selections are not approved, apply additional benchmark samples of additional colors selected by Architect at no added cost to Owner.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.
 - 1. Maintain containers in clean condition, free of foreign materials and residue.
 - 2. Remove rags and waste from storage areas daily.

1.06 PROJECT CONDITIONS

- A. Apply coatings only when temperature of surfaces to be coated and surrounding air temperatures are between 50 and 95 deg F.
- B. Do not apply coatings in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

1.07 EXTRA MATERIALS

- A. Furnish extra materials described below that are from same production run (batch mix) as materials applied and that are packaged for storage and identified with labels describing contents.
 - 1. Quantity: Furnish an additional 5 percent, but not less than 1 gallon of each material and color applied.

PART 2 - PRODUCTS

2.01 HIGH-PERFORMANCE COATINGS, GENERAL

- A. Material Compatibility:
 - 1. Provide materials for use within each coating system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 - 2. Provide products of same manufacturer for each coat in a coating system.
- B. VOC Content for Interior Paints and Coatings:
 - 1. All interior paints and coatings shall comply with the VOC content regulations of the Ozone Transportation Commission (OTC) effective in the Commonwealth of Massachusetts. For interior paints and coatings applied at Project site, the following VOC limits, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - a. Floor Paint: 100 g/L.
- C. Color: As selected by Architect from manufacturer's full range.

2.02 HIGH PERFORMANCE COATINGS

- A. Basis of Design Product: Subject to compliance with requirements, provide products indicated by **Tnemec Company** or comparable products by one of the following:
 - 1. DuPont, Inc. Commercial Finishes.
 - 2. International Protective Coatings.
- B. Interior Concrete and Masonry:
 - 1. Coat 1: Tnemec Series 156 Enviro-Crete @ 8 mils DFT
 - 2. Coat 2: Tnemec Series 156 Enviro-Crete @ 8 mils DFT

C. Interior Concrete Slabs:

1. Surface Preparation: SSPC-SP13 to achieve a surface profile of ICRI 2-3
2. Coat 1: Tnemec Series 241 UltraTread MVT at 1/8" with 30/50 mesh sand broadcast
3. Coat 2: Tnemec Series 280 TnemeGlaze at 10-12 mils DFT
4. Coat 3: Tnemec Series 280 TnemeGlaze at 6-8 mils DFT

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.
1. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 - a. Concrete: 12 percent.
 - b. Masonry (Clay and CMU): 12 percent.
- B. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- C. Proceed with coating application only after unsatisfactory conditions have been corrected.
1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

3.02 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates indicated.
- B. Surface Preparation: Shall be a full abrasive blast cleaning per SSPC-SP6 Commercial Blast. Abrasive blast cleaned surfaces shall exhibit a uniform, angular profile of 1.0 – 2.0 mils. Cleaned surfaces shall be primed within 8 hours of cleaning and prior to any surface rusting.
- C. Remove plates, machined surfaces, and similar items already in place that are not to be coated. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and coating.

1. After completing coating operations, reinstall items that were removed; use workers skilled in the trades involved.
- D. Clean substrates of substances that could impair bond of coatings, including dirt, oil, grease, and incompatible paints and encapsulants.
1. Remove incompatible primers and reprime substrate with compatible primers as required to produce coating systems indicated.
- E. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.
1. Alkalinity and Adhesion Testing: Perform tests recommended by resilient sheet flooring manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 7 or more than 9 pH.
 2. Moisture Testing: Proceed with installation only after substrates pass testing according to resilient sheet flooring manufacturer's written recommendations, but not less stringent than the following:
 - a. Perform anhydrous calcium chloride test according to ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lbs. of water/1000 sq. ft. in 24 hours.
 - b. Perform relative humidity test using in situ probes according to ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level.
 3. Clean surfaces with pressurized water as indicated.
- F. New Masonry Substrates: Remove efflorescence and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces or if alkalinity of mortar joints exceed that permitted in manufacturer's written instructions.
1. Clean surfaces with pressurized water.

3.03 APPLICATION

- A. Apply high-performance coatings according to manufacturer's written instructions.
1. Use applicators and techniques suited for coating and substrate indicated.
 2. Coat surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, coat surfaces behind permanently fixed equipment or furniture with prime coat only.
 3. Coat back sides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.

- B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of the same material are to be applied. Tint undercoats to match color of finish coat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through final coat, apply additional coats until cured film has a uniform coating finish, color, and appearance.
- D. Apply coatings to produce surface films without cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections. Produce sharp glass lines and color breaks.

3.04 FIELD QUALITY CONTROL

- A. Owner reserves the right to invoke the following procedure at any time and as often as Owner deems necessary during the period when coatings are being applied:
 - 1. Owner may engage the services of a qualified testing agency to sample coating material being used. Samples of material delivered to Project site will be taken, identified, sealed, and certified in presence of Contractor.
 - 2. Testing agency will perform tests for compliance with specified requirements.
 - 3. Owner may direct Contractor to stop applying coatings if test results show materials being used do not comply with specified requirements. Contractor shall remove noncomplying coating materials from Project site, pay for testing, and recoat surfaces coated with rejected materials. Contractor will be required to remove rejected materials from previously coated surfaces if, on recoating with complying materials, the two coatings are incompatible.

3.05 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing coating application, clean spattered surfaces. Remove spattered coatings by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from coating operation. Correct damage by cleaning, repairing, replacing, and recoating, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced coated surfaces.

END OF SECTION

DIVISION 10

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 10155
TOILET COMPARTMENTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section includes
 - 1. Phenolic-core toilet compartments configured as toilet enclosures.
- B. Related Sections include the following:
 - 1. Division 10 "Toilet and Bath Accessories" for toilet tissue dispensers, grab bars, and similar accessories.

1.03 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Show locations of cutouts for compartment-mounted toilet accessories.
 - 2. Show locations of reinforcements for compartment-mounted grab bars.
- C. Samples for Initial Selection: For each type of unit indicated.
- D. Samples for Verification: Of each type of color and finish required for units, prepared on 6-inch- square Samples of same thickness and material indicated for Work.

1.04 QUALITY ASSURANCE

- A. Comply with requirements in CID-A-A-60003, "Partitions, Toilets, Complete."

- B. Accessibility: Comply with applicable provisions in AAB and the 2010 ADA Standards.
- C. Fire Performance Characteristics: Provide materials with surface burning characteristics indicated below, per NFPA 255, “Method of Test of Surface Burning Characteristics of Building Materials”, ASTM E84, by a testing organization acceptable to authorities having jurisdiction.
 - 1. Flame Spread: 26 – 75.
 - 2. Smoke Developed: 0 – 450.

1.05 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements before fabrication and indicate measurements on Shop Drawings.

1.06 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of phenolic partitions, including panels, doors, stiles, and continuous hinges that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Breakage, corrosion, delamination and defects in factory workmanship.
 - 2. Warranty Period: 25 years from date of Substantial Completion.
 - 3. Warranty Period for Stainless Steel hardware: One year from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 PHENOLIC-CORE UNITS

- A. Basis of Design Product: Subject to compliance with requirements, provide **Bobrick; DuraLine Series CGL** or comparable product by one of the following:
 - 1. ASI Accurate and Global Partitions.
 - 2. General Partitions Mfg. Corp.
 - 3. Partition Systems International of South Carolina.

- B. Toilet-Enclosure Style: Overhead braced.
 - 1. Extended height.
 - a. Door/Panel Height: 96 inches.
 - b. Floor Clearance: 1 inch.
 - 2. Privacy Style Partitions: No sightlines with gap-free interlocking doors and stiles routed 0.300 inches from the edge to allow for 0.175 inch overlap to prevent line-of-sight into the toilet compartment. Privacy strips fastened or adhered onto the partition material are not acceptable.
- C. Door, Panel and Pilaster Construction: Solid phenolic-core panel material with melamine facing on both sides fused to substrate during panel manufacture (not separately laminated), and with eased and polished edges.
 - 1. Facing Sheet Color: As selected by Architect from manufacturer's full range.
 - 2. Core Color: Black.
 - 3. Doors and Pilasters: 3/4-inch- thick.
 - 4. Panels: 1/2-inch- thick.
- D. Pilaster Shoes and Sleeves (Caps): Stainless steel, ASTM A 666, Type 302 or 304, not less than 20 gauge thickness and 3 inches high, finished to match hardware.
- E. Brackets (Fittings):
 - 1. Full-Height (Continuous) Type: Manufacturer's standard design; stainless steel.

2.02 ACCESSORIES

- A. Hardware and Accessories: Manufacturer's standard design, heavy-duty operating hardware and accessories.
 - 1. Material: Stainless steel.
- B. Overhead Bracing: Manufacturer's standard continuous, extruded-aluminum head rail with antigrip profile and in manufacturer's standard finish.
- C. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel or chrome-plated steel or brass, finished to match hardware, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use hot-dip galvanized or other rust-resistant, protective-coated steel.

2.03 FABRICATION

- A. Overhead-Braced Units: Provide manufacturer's standard corrosion-resistant supports, leveling mechanism, fasteners, and anchors at pilasters to suit floor conditions. Make provisions for setting and securing continuous head rail at top of each pilaster. Provide shoes at pilasters to conceal supports and leveling mechanism.
- B. Doors: Unless otherwise indicated, provide 24-inch- wide in-swinging doors for standard toilet compartments and 36-inch- wide out-swinging doors with a minimum 32-inch- wide clear opening for compartments indicated to be accessible to people with disabilities. Furnish hardware for each compartment to comply with the requirements of AAB, 2010 ADA Standards, and as follows:
 - 1. Hinges: Manufacturer's standard continuous, full-height, 14 gauge edge mount stainless steel, continuous gravity type hinge that swings to a closed position.
 - 2. Latch and Keeper: Manufacturer's standard, heavy-duty cast stainless steel, surface-mounted latch unit with combination rubber-faced door strike and keeper.
 - 3. Coat Hook: Manufacturer's standard combination hook and rubber-tipped bumper, sized to prevent door from hitting compartment-mounted accessories.
 - 4. Door Bumper: Manufacturer's standard rubber-tipped bumper, heavy-duty cast stainless steel, at out-swinging doors.
 - 5. Door Pull: Manufacturer's standard unit, 4-inch long stainless steel wire pull, at out-swinging doors. Provide units on both sides of doors at compartments indicated to be accessible to people with disabilities.
 - a. Mount door pull on inside of handicapped accessible stalls at 36 inches above the floor, located at 6 inches from hinge side of door.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.
 - 1. Maximum Clearances:
 - a. Pilasters and Panels: 1/2 inch.
 - b. Panels and Walls: 1 inch.
- B. Overhead-Braced Compartments: Secure pilasters to floor, and level, plumb, and tighten. Set pilasters with anchors penetrating not less than 2 inches into structural floor unless otherwise indicated in manufacturer's written instructions. Secure continuous head rail to each pilaster with no fewer than two fasteners.

3.02 ADJUSTING

- A. Hardware Adjustment: Adjust and lubricate hardware according to manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors to return doors to fully closed position.

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 10240
EQUIPMENT SCREENS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section Includes:

- 1. Fixed, extruded-aluminum louver screens for rooftop installation as equipment screens.

- B. Related Requirements:

- 1. Division 5 Section "Structural Steel Framing" for structural steel framing supporting equipment louver screens.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product.

- B. Shop Drawings: For louvers and accessories. Include plans, elevations, sections, details, and attachments to other work. Show frame profiles and blade profiles, angles, and spacing.

- 1. Show mullion profiles and locations.

- C. Samples: For each type of metal finish required.

- D. Delegated-Design Submittal: For louvers indicated to comply with structural and seismic performance requirements, including analysis data signed and sealed by the qualified professional engineer licensed in the Commonwealth of Massachusetts responsible for their preparation.

- E. Warranty: Special warranty included in this Section.

1.04 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."

1.05 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of louver systems that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: One year from date of Substantial Completion.
- B. Special Finish Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components on which finishes do not comply with requirements or that fail in materials or workmanship within specified warranty period. Warranty does not include normal weathering.
 - 1. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Source Limitations: Obtain louvers from single source from a single manufacturer.

2.02 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design louvers, including comprehensive engineering analysis by a qualified professional engineer, using structural and seismic performance requirements and design criteria indicated.
- B. Structural Performance: Louvers shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of louver components, noise or metal fatigue caused by louver-blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures shall be considered to act normal to the face of the building.
 - 1. Wind Loads: As indicated on Structural Drawings.
 - a. Basic Wind Speed: 120 mph.
 - b. Importance Factor: IV.
 - c. Exposure Category: B.

- C. Seismic Performance: Louvers, including attachments to other construction, shall withstand the effects of earthquake motions determined according to the Massachusetts State Building Code.
- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
 - 1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.
- E. SMACNA Standard: Comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" for fabrication, construction details, and installation procedures.

2.03 FIXED, EXTRUDED-ALUMINUM LOUVERS

- A. Horizontal, Inverted-Blade Louver:
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide **Construction Specialties; Vert-A-Cade 301** or comparable product by one of the following:
 - a. AiroLite Company, LLC (The).
 - b. Industrial Louvers, Inc.
 - c. Ruskin Company; Tomkins PLC.
 - 2. Blade Depth: 4 inches.
 - 3. Blade Profile: Inverted horizontal blade, stationary, spaced 6-3/4 inches on center.
 - 4. Frame and Blade Nominal Thickness: Not less than 0.068 inch.

2.04 MATERIALS

- A. Aluminum Extrusions: ASTM B 221, Alloy 6063-T5, T-52, or T6.
- B. Aluminum Sheet: ASTM B 209, Alloy 3003 or 5005 with temper as required for forming, or as otherwise recommended by metal producer for required finish.
- C. Fasteners: Use types and sizes to suit unit installation conditions.
 - 1. Use Phillips flat-head screws for exposed fasteners unless otherwise indicated.
 - 2. For fastening aluminum, use stainless-steel fasteners.
 - 3. For color-finished louvers, use fasteners with heads that match color of louvers.

2.05 FABRICATION

- A. Factory assemble louvers to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

- B. Maintain equal louver blade spacing to produce uniform appearance.
- C. Fabricate equipment screen and frames to top and bottom slopes indicated on Drawings, will blades parallel to siding below.
 - 1. Provide framed swinging gate fabricated from fixed louver to match equipment screen.
 - 2. Provide stainless steel continuous hinge and flush bolt.
 - 3. Align louver blades in swinging gate with adjacent equipment screen.
- D. Include supports, anchorages, and accessories required for complete assembly.
- E. Provide concealed vertical mullions of type and at spacings indicated, but not more than is recommended by manufacturer, or 72 inches o.c., whichever is less.
 - 1. Fully Recessed Mullions: Where indicated, provide mullions fully recessed behind louver blades. Where length of louver exceeds fabrication and handling limitations, fabricate with close-fitting blade splices designed to permit expansion and contraction.
 - 2. Exterior Corners: Prefabricated corner units with mitered and welded blades and with fully recessed mullions at corners.
- F. Join frame members to each other and to fixed louver blades with fillet welds concealed from view, threaded fasteners, or both, as standard with louver manufacturer unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

2.06 ALUMINUM FINISHES

- A. Finish louvers after assembly.
- B. High-Performance Organic Finish: Two-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - 1. Color: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Coordinate setting drawings, diagrams, templates, instructions, and directions for installation of anchorages that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to Project site.

3.03 INSTALLATION

- A. Locate and place louvers level, plumb, and at indicated alignment with adjacent work.
- B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.
- C. Form closely fitted joints with exposed connections accurately located and secured.

3.04 ADJUSTING AND CLEANING

- A. Clean exposed louver surfaces that are not protected by temporary covering, to remove fingerprints and soil during construction period. Do not let soil accumulate during construction period.
- B. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.
- C. Restore louvers damaged during installation and construction so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Architect, remove damaged units and replace with new units.
 - 1. Touch up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory-applied finish coating.

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 10431

SIGNAGE

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes the following:
 - 1. Dimensional characters for exterior use (pin letters).
 - 2. Plaques.
- B. Related Sections include the following:
 - 1. Division 16 Sections for illuminated Exit signs.

1.03 DEFINITIONS

- A. Accessible: In accordance with the accessibility standard.

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show fabrication and installation details for signs.
 - 1. Include fabrication and installation details and attachments to other work.
 - 2. Show sign mounting heights, locations of supplementary supports to be provided by others, and accessories.
- C. Samples for Initial Selection: For each type of sign material indicated that involves color selection.
 - 1. Include representative Samples of available typestyles and graphic symbols.

- D. Samples for Verification: For each of the following products and for the full range of color, texture, and sign material indicated, of sizes indicated:
 - 1. Plaque: 6 inches square including border.
 - 2. Dimensional Characters: Full-size Samples of each type of dimensional character (letter, number, and graphic element).

1.05 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For fabricator.
- B. Warranty: Special warranty specified in this Section.

1.06 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For signs to include in maintenance manuals.

1.07 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative of signage manufacturer.
- B. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.
- C. Source Limitations for Signs: Obtain each sign type indicated from one source from a single manufacturer.
- D. Regulatory Requirements: Comply with handicapped accessibility requirements of the 2010 ADA Standards and AAB.

1.08 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit installation of signs in exterior locations to be performed according to manufacturers' written instructions and warranty requirements.

1.09 COORDINATION

- A. Coordinate placement of anchorage devices with templates for installing signs.

1.10 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: One year from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Thermal Movements: For exterior signs, allow for thermal movements from ambient and surface temperature changes.
 - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.02 DIMENSIONAL CHARACTERS (PIN LETTERS)

- A. Basis of Design Products: Subject to compliance with requirements, provide **ASI Sign Systems; LPS Series** or comparable product by one of the following:
 - 1. Gemini Incorporated.
 - 2. Southwell Co. (The).
- B. Cutout Characters (Exterior): Provide characters with square-cut, smooth edges. Comply with the following requirements:
 - 1. Thickness: 1- inch thick.
 - 2. Character Material:
 - a. Integral Aluminum Finish: Clear anodized.
- C. Dimensional Character Schedule:
 - 1. Character Sizes: As indicated.
 - 2. Font: As selected by Architect from manufacturer's full range.
 - 3. Text/Message: As indicated.

2.03 PLAQUES

- A. Basis of Design Product: Subject to compliance with requirements, provide **A.R.K. Ramos Signage Systems; Cast Plaques** or comparable product by one of the following:
 - 1. Gemini Incorporated.
 - 2. Matthews International Corporation, Bronze Division.
 - 3. Southwell Co. (The).
- B. General: Provide castings free from pits, scale, sand holes, and other defects. Comply with requirements specified for metal, border style, background texture, and finish and in required thickness, size, shape, and copy.
 - 1. Provide the following:
 - a. Size: 24-inches by 36-inches.
 - b. Copy: Furnish copy in format provided by the Architect.
 - c. Furnish and install one plaque in location as determined by the Architect.
 - 2. Plaque Material: Bronze.
 - 3. Background Texture: Manufacturer's standard leatherette finish.
 - 4. Border Style: Plain bevel.
 - 5. Mounting: Concealed fasteners matching plaque finish for substrates encountered.

2.04 ACCESSORIES

- A. Anchors and Inserts: Provide nonferrous-metal or hot-dip galvanized anchors and inserts for exterior installations and elsewhere as required for corrosion resistance. Use toothed steel or lead expansion-bolt devices for drilled-in-place anchors.
- B. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.05 FABRICATION

- A. General: Provide manufacturer's standard signs of configurations indicated.
- B. Dimensional Characters: Comply with requirements indicated for materials, thicknesses, finishes, colors, designs, shapes, sizes, and details of construction.
 - 1. Design, fabricate, and install sign assemblies to prevent buckling, opening up of joints, and over-stressing of welds and fasteners.
 - 2. Mill joints to a tight, hairline fit. Form joints exposed to the weather to exclude water penetration.

3. Conceal fasteners if possible; otherwise, locate fasteners where they will be inconspicuous.
4. Provide rebates, lugs, and brackets necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match sign finish.
5. Castings: Fabricate castings free of warp, cracks, blowholes, pits, scale, sand holes, and other defects that impair appearance or strength. Grind, wire brush, sandblast, and buff castings to remove seams, gate marks, casting flash, and other casting marks before finishing.
6. Create signage to required sizes and layout.

2.06 FINISHES, GENERAL

- A. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.07 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, Class I, 0.018 mm or thicker.

2.08 COPPER-ALLOY FINISHES

- A. Cast-Bronze Plaque Finishes: Exposed surfaces free from porosity, burrs, and rough spots; with returns finished with fine-grain air blast.
 1. Raised Areas: Hand-tool and buff borders and raised copy to produce manufacturer's standard satin finish.
 2. Background Finish: Dark oxidized.
- B. Clear Protective Coating: Coat exposed surfaces of copper alloys with manufacturer's standard clear organic coating specially designed for coating copper-alloy products.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of signage work.

- B. Verify that sign-support surfaces are within tolerances to accommodate signs without gaps or irregularities between backs of signs and support surfaces unless otherwise indicated.
- C. Verify that anchor inserts are correctly sized and located to accommodate signs.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Locate signs and accessories where indicated, using mounting methods of types described and complying with manufacturer's written instructions.
 - 1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
 - 2. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.
 - 3. Corrosion Protection: Coat concealed surfaces of exterior aluminum in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.
- B. Dimensional Characters: Mount characters using standard fastening methods to comply with manufacturer's written instructions for character form, type of mounting, wall construction, and condition of exposure indicated. Provide heavy paper template to establish character spacing and to locate holes for fasteners.
 - 1. Projecting Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.
 - a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place spacers on studs, place sign in position, and push until spacers are pinched between sign and substrate, embedding the stud ends in holes. Temporarily support sign in position until adhesive fully sets.
 - b. Thin or Hollow Surfaces: Place spacers on studs, place sign in position with spacers pinched between sign and substrate, and install washers and nuts on stud ends projecting through opposite side of surface, and tighten.
- C. Plaques: Mount plaques using standard fastening methods recommended in writing by manufacturer for type of wall surface indicated.
 - 1. Concealed Mounting: Mount plaques by inserting threaded studs into tapped lugs on back of plaque. Set in predrilled holes filled with quick-setting cement.

3.03 ADJUSTING AND CLEANING

- A. Remove and replace damaged or deformed signs and signs that do not comply with specified requirements. Replace signs with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.
- B. Remove temporary protective coverings and strippable films as signs are installed.
- C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions, and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by Owner.

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 10605
WIRE MESH PARTITIONS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section Includes:

- 1. Standard-duty, full height wire mesh partition doors.

- B. Related Sections:

- 1. Division 8 Section "Door Hardware" for door hardware furnished and installed on wire mesh swing door.

1.03 DEFINITIONS

- A. As defined in ASTM E 2016:

- 1. Intermediate Crimp: Wires pass over one and under the next adjacent wire in both directions, with wires crimped before weaving and with extra crimps between the intersections.
 - 2. Lock Crimp: Deep crimps at points of the intersection that lock wires securely in place.

1.04 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Wire mesh units shall withstand the effects of gravity loads and the loads and stresses within limits and under conditions indicated according to SEI/ASCE 7 and the Massachusetts State Building Code.

1.05 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for wire mesh items.

- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Include clearances required for operation of doors and gates.
- C. Setting Drawings: For anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in masonry.
- D. Samples for Initial Selection: For units with factory-applied color finishes.
- E. Samples for Verification: 12-by-12-inch panel constructed of specified frame members and wire mesh. Show method of finishing members at intersections.
- F. Qualification Data: For qualified Installer and professional engineer.
- G. Welding certificates.
- H. Maintenance Data: For wire mesh unit hardware to include in maintenance manuals.

1.06 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers trained and approved by manufacturer.
 - 1. Installer's responsibilities include fabricating and installing wire mesh items and providing professional engineering services needed to assume engineering responsibility.
 - 2. Engineering Responsibility: Preparation of data for wire mesh items, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.
- B. Source Limitations: Obtain wire mesh items from single source from single manufacturer.
- C. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 - 2. AWS D1.3, "Structural Welding Code - Sheet Steel."
- D. Preinstallation Conference: Conduct conference at Project site.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver wire mesh items with cardboard protectors on perimeters of panels and doors and with posts wrapped to provide protection during transit and Project-site storage. Use vented plastic.

- B. Inventory wire mesh partition door hardware on receipt and provide secure lockup for wire mesh partition door hardware delivered to Project site.
 - 1. Tag each item or package separately with identification and include basic installation instructions with each item or package.
- C. Deliver keys to Owner.

1.08 PROJECT CONDITIONS

- A. Field Measurements: Verify actual dimensions of construction contiguous with wire mesh units by field measurements before fabrication.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Acorn Wire & Iron Works, Inc.
 - 2. G-S Company (The).
 - 3. Hartford Wire Works Company, Inc.

2.02 MATERIALS

- A. Steel Wire: ASTM A 510.
- B. Steel Plates, Channels, Angles, and Bars: ASTM A 36/A 36M.
- C. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B.
- D. Square Steel Tubing: ASTM A 500, cold-formed structural-steel tubing.
- E. Postinstalled Expansion Anchors: With capability to sustain, without failure, load imposed within factors of safety indicated, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.
 - 1. Stainless Steel: ASTM F 593 and ASTM F 594, Alloy Group 1 or 2, for bolts and nuts; ASTM A 276 or ASTM A 666, Type 304 or 316, for anchors.
 - 2. For Postinstalled Anchors in Concrete: Capability to sustain, without failure, a load equal to four times the loads imposed.

- F. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated and fabricated from corrosion-resistant materials; with clips or other accessory devices for attaching hangers of type indicated, and with capability to sustain, without failure, a load equal to 10 times that imposed by wire mesh construction, as determined by testing per ASTM E 1190, conducted by a qualified testing and inspecting agency.

2.03 STANDARD-DUTY WIRE MESH PARTITIONS

- A. Mesh: No. 10 gauge, intermediate-crimp steel wire woven into 1-1/2-inch diamond mesh.
- B. Vertical Panel Framing: 1-1/4-by-5/8-by-13 gauge cold-rolled, C-shaped steel channels with 1/4-inch- diameter bolt holes spaced not more than 18 inches o.c. along center of framing.
- C. Horizontal Panel Framing: 1-by-1/2-by-11 gauge cold-rolled steel channels with all mortise and tenon joints.
- D. Horizontal Panel Stiffeners: 2 cold-rolled steel channels, not less than 1-by-1/2-by-11 gauge cold-rolled steel channels riveted toe to toe through mesh and welded to vertical frames.
- E. Top Capping Bars: 2-1/4-by-1-inch cold-rolled steel channels.
- F. Line Posts: 3-inch-by-4.1-lb steel channels; with 5-by-18-by-5/16-inch steel base plates punched for attachment to floor.
- G. Floor Shoes: Steel, 2 inches high; sized to suit vertical framing, drilled for attachment to floor, and with set screws for leveling adjustment.
- H. Swinging Doors: Fabricated from same mesh as partitions, with framing fabricated from 1-1/4-by-1/2-by-11 gauge steel channels or C-channels, banded with 1-1/4-by-1/8-inch flat steel bar cover plates on 3 sides, and with 1-3/8-by-3/4-inch angle strike bar and cover welded on strike jamb.
 - 1. Hinges: Full-surface type, 3-by-3-inch steel, 1-1/2 pairs per door; bolted, riveted, or welded to door and jamb framing.
 - 2. Lock: Furnished and installed by Division 08 Section "Door Hardware."
 - 3. Inactive Leaf Hardware: Cane bolt at bottom and chain bolt at top.
- I. Accessories:
 - 1. Wall Clips: Manufacturer's standard, cold-rolled steel sheet.

J. Insect Screens:

1. Glass-Fiber Mesh Fabric: 18-by-16 mesh of PVC-coated, glass-fiber threads; woven and fused to form a fabric mesh resistant to corrosion, shrinkage, stretch, impact damage, and weather deterioration. Comply with ASTM D3656/D3656M.
 - a. Mesh Color: Manufacturer's standard.

K. Finish for Uncoated Ferrous Steel: Electrostatically sprayed enamel.

1. Color: As selected by Architect from manufacturer's full range.

2.04 FABRICATION

A. General: Fabricate wire mesh items from components of sizes not less than those indicated. Use larger-sized components as recommended by wire mesh item manufacturer. As required for complete installation, provide bolts, hardware, and accessories with manufacturer's standard finishes.

1. Fabricate wire mesh items to be readily disassembled.
2. Welding: Weld corner joints of framing and grind smooth, leaving no evidence of joint.

B. Standard-Duty Wire Mesh Partitions: Fabricate wire mesh partitions with cutouts for pipes, ducts, beams, and other items indicated. Finish edges of cutouts to provide a neat, protective edge.

1. Mesh: Securely clinch mesh to framing.
2. Framing: Fabricate framing with mortise and tenon corner construction.
 - a. Provide horizontal stiffeners as indicated or, if not indicated, as required by panel height and as recommended by wire mesh partition manufacturer. Weld horizontal stiffeners to vertical framing.
 - b. Fabricate three- and four-way intersections using intersection posts.
 - c. Fabricate partition and door framing with slotted holes for connecting adjacent panels.
3. Fabricate wire mesh partitions with 3 inches of clear space between finished floor and bottom horizontal framing.
4. Doors: Align bottom of door with bottom of adjacent panels.
5. Hardware Preparation: Mortise, reinforce, drill, and tap doors and framing as required to install hardware.

2.05 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

2.06 STEEL AND IRON FINISHES

- A. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with minimum requirements indicated below for SSPC surface-preparation specifications and environmental exposure conditions of installed metal fabrications:
 - 1. Interiors (SSPC Zone 1A): SSPC-SP 3, "Power Tool Cleaning."
- B. Shop Priming: Apply shop primer to uncoated surfaces of metal fabrications, except those with galvanized finishes and those to be embedded in concrete or masonry, unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
 - 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
- C. Shop Coat Finish: Immediately after cleaning and pretreating, apply manufacturer's standard one-coat, shop-coat finish suitable for use intended. Comply with paint manufacturer's written instructions for applying and curing.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine floors for suitable conditions where wire mesh items will be installed.
- C. Examine walls to which wire mesh items will be attached for properly located blocking, grounds, and other solid backing for attachment of support fasteners.
- D. Proceed with installation only after unsatisfactory conditions have been corrected. Commencement of the work indicates acceptance of substrates.

3.02 WIRE MESH PARTITIONS ERECTION

- A. Anchor wire mesh partitions to floor with 3/8-inch- diameter, postinstalled expansion anchors at 12 inches o.c. through floor shoes located at each post and corner. Adjust wire mesh partition posts in floor shoes to achieve level and plumb installation.
 - 1. Anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if indicated on Shop Drawings.
- B. Anchor wire mesh partitions to walls as required at 12 inches o.c. through back corner panel framing.
- C. Secure top capping bars to top framing channels with 1/4-inch- diameter "U" bolts spaced not more than 28 inches o.c.
- D. Where standard-width wire mesh partition panels do not fill entire length of run, provide adjustable filler panels to fill openings.
- E. Install doors complete with door hardware.
- F. Weld or bolt sheet metal bases to wire mesh partitions and doors.
- G. Bolt accessories to wire mesh partition framing.

3.03 ADJUSTING AND CLEANING

- A. Adjust doors to operate smoothly and easily, without binding or warping. Adjust hardware to function smoothly. Confirm that latches and locks engage accurately and securely without forcing or binding.
- B. Remove and replace defective work including doors and framing that are warped, bowed, or otherwise unacceptable.
- C. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

END OF SECTION

SECTION 10801

TOILET AND BATH ACCESSORIES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes the following:
 - 1. Washroom accessories.
- B. Related Sections include the following:
 - 1. Division 15 Plumbing Section for underlavatory guards.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include the following:
 - 1. Construction details and dimensions.
 - 2. Anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
 - 3. Material and finish descriptions.
 - 4. Features that will be included for Project.
- B. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.
 - 1. Identify locations using room designations indicated on Drawings.
 - 2. Identify products using designations indicated on Drawings.

1.04 INFORMATIONAL SUBMITTALS

- A. Warranty: Sample of special warranty.

1.05 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For toilet and bath accessories to include in maintenance manuals.

1.06 QUALITY ASSURANCE

- A. Source Limitations: For products listed together in the same articles in Part 2, provide products of same manufacturer unless otherwise approved by Architect.
- B. Accessibility: Comply with applicable provisions in AAB and the 2010 ADA Standards.

1.07 COORDINATION

- A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.
- B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

1.08 WARRANTY

- A. Special Mirror Warranty: Manufacturer's standard form in which manufacturer agrees to replace mirrors that develop visible silver spoilage defects and that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: 15 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Stainless Steel: ASTM A 666, Type 304, 0.0312-inch minimum nominal thickness, unless otherwise indicated.
- B. Steel Sheet: ASTM A 1008/A 1008M, Designation CS (cold rolled, commercial steel), 0.0359-inch minimum nominal thickness.
- C. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.
- D. Mirrors: ASTM C 1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.

2.02 WASHROOM ACCESSORIES

A. Basis-of-Design Product: Subject to compliance with requirements, provide products indicated by **Bobrick Washroom Equipment, Inc.** or a comparable product by one of the following:

1. American Specialties, Inc.
2. Bradley Corporation.

B. Toilet Tissue (Roll) Dispenser:

1. Basis-of-Design Product: **Bobrick; B-4288.**
2. Description: Double-roll dispenser.
3. Mounting: Surface mounted.
4. Operation: Noncontrol delivery with theft-resistant spindle. Tissue rolls are loaded and locked into dispensing mechanism. Extra roll automatically drops in place when bottom roll is depleted. Depleted rolls can only be removed after unlocking door.
5. Capacity: Designed for up to 10-inch- diameter, 3-inch diameter core tissue rolls.
6. Material and Finish: Stainless steel, No. 4 finish (satin) with heavy-duty one-piece ABS plastic spindles.
 - a. Cabinet: 22 gauge stainless steel, all-welded construction.
 - b. Door: 22 gauge stainless steel with 18 gauge stainless steel door frame. Front of door is drawn, one-piece seamless construction, secured to cabinet with two rivets.
 - c. Dispensing mechanism: 18 gauge stainless steel.
 - d. Spindles: Heavy duty, theft resistant, one-piece molded ABS. Spindles are retained in dispensing unit when door is locked.
7. Lockset: Tumbler type.

C. Liquid-Soap Dispenser:

1. Basis-of-Design Product: **Bobrick; B-2012.**
2. Description: Designed for dispensing all commercially marketed all-purpose soap in liquid form, automatic.
3. Mounting: Vertically oriented, surface mounted.
4. Capacity: 30 fl oz.
5. Material and Finish: Stainless steel, No. 4 finish (satin).
 - a. Container: 18 gauge stainless steel, drawn, one-piece seamless construction. Equip with a plastic back plate. Furnish with concealed wall plate.
 - b. Valve: No touch, sensor activated.
6. Lockset: Tumbler type.

7. Refill Indicator: Window type, clear acrylic and unbreakable.
8. Battery Operation: Three, C cell batteries.

D. Paper Towel (Roll) Dispenser:

1. Basis-of-Design Product: **Bobrick; B-262.**
2. Mounting: Surface mounted.
3. Minimum Capacity: 400 C-fold or 525 multifold towels.
4. Material and Finish: Stainless steel, No. 4 finish (satin).
 - a. Cabinet: 22 gauge stainless steel, all-welded construction. Provide towel tray with hemmed opening to dispense towels without tearing.
 - b. Door: 22 gauge stainless steel, secured to cabinet with a full-length stainless steel piano-hinge.
5. Lockset: Tumbler type.
6. Refill Indicators: Pierced slots at sides or front.

E. Mirror Unit:

1. Basis-of-Design Product: **Bobrick; B-165 Series.**
2. Frame: Type 430 stainless-steel channel, 1/2" x 1/2" x 3/8" channel with 1/4" return at rear with bright polished finish, one-piece roll-formed construction.
 - a. Corners: Welded and ground smooth.
 - b. Backing: Galvanized steel fastened to frame with concealed screws and equipped with integral horizontal hanging brackets near the top and bottom of the mirror.
3. Hangers: Produce rigid, tamper- and theft-resistant installation, using method indicated below.
 - a. Wall bracket of 20 gauge galvanized steel, equipped with concealed locking devices requiring a special tool to remove.
4. Mirror: No. 1 quality, 1/4-inch select float glass, with all edges protected by plastic filler strips. Provide protective backing of full-size, shock absorbing, water resistant, nonabrasive, 3/16-inch thick polyethylene padding.
5. Size: 18 by 36 inches.

2.03 FABRICATION

- A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.

- B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.
- B. Grab Bars: Install to withstand a downward load of at least 250 lbf, when tested according to method in ASTM F 446.

3.02 ADJUSTING AND CLEANING

- A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.
- B. Remove temporary labels and protective coatings.
- C. Clean and polish exposed surfaces according to manufacturer's written recommendations.

END OF SECTION

DIVISION 11

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 11282

STAINLESS STEEL SLUICE GATES AND APPURTENANCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Furnish, install and test stainless steel sluice gates and appurtenances as indicated and specified.
 - 1. Sizes are indicated in the gate schedules on the Drawings.
- B. Related Sections: The following sections contain requirements that relate to this Section:
 - 1. Division 1 - General Requirements
 - 2. Section 02050 - Demolition
 - 3. Division 16 – Electrical Work

1.3 SUBMITTALS

- A. Shop Drawings and Product Data:
 - 1. Comply with the requirements of Section 01300 - Submittals.
 - 2. Submit Shop Drawings showing the following:
 - a. Complete description in sufficient detail to permit item-by-item comparison with the Specifications.
 - b. Dimensions.
 - c. Weights.
 - d. Capacity.

- e. Maximum support reactions.
- f. Performance characteristics.
- g. Layout drawing for all equipment showing installation details.
- h. Wiring diagrams for all electrical items (both internal and external)
- i. Deviations from Drawings and Specifications.
- j. Manufacturer's installation and testing instructions.
- m. Affidavits of compliance with referenced standards and codes.
 - 1. Manufacturer's standard guarantee.
- m. Submit Manufacturer's installation report as specified in Part 3.

B. Operation and Maintenance Manuals:

- 1. Comply with the Requirements of Division 1 and the Supplemental Requirements Below.
- 2. Required Operation Data:
 - a. Complete, detailed operating instructions for each piece of equipment.
 - b. Explanations of all safety considerations relating to operation.
- 3. Required Maintenance Data:
 - a. Include all information and instructions required to keep equipment properly lubricated and adjusted so that it functions economically throughout its full design life.
 - b. Explanation with illustrations as necessary for each maintenance task.
 - c. Recommended spare parts lists.
 - d. Recommended schedule of maintenance tasks.
 - e. Lubrication charts and table of alternate lubricants.
 - f. Troubleshooting instructions.

- g. List of special maintenance tools and equipment.
- h. Name, address and phone number of manufacturer and manufacturer's local service.
- i. Include copies of all approved Shop Drawings.

1.4 QUALITY ASSURANCE

A. Manufacturer's Qualifications:

- 1. Manufacturer shall have a minimum of ten years experience in producing similar type equipment, and shall show evidence of ten installations in satisfactory operation upon request.

B. Reference Standards: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.

- 1. AWWA C561 Standard for Fabricated Stainless Steel Slide Gates.
- 2. ASTM A276, stainless and heat-resisting steel bars and shapes.
- 3. ASTM A480, stainless steel plate, sheet, and strip.
- 4. ASTM B584, copper alloy and sand castings for general application.
- 5. ASTM D4020, U.H.M.W. polyethylene molding and extrusion material.
- 6. ASTM D2000, standard classification system for rubber products in automotive applications.
- 7. ASTM B26, aluminum alloy sand castings.

1.5 DELIVERY, STORAGE AND HANDLING

A. Provide in accordance with Section 01600 and as specified.

B. Shipping:

- 1. Ship equipment, material and spare parts complete except where partial disassembly is required by transportation regulations or for protection of components.

2. Pack spare parts in containers bearing labels clearly designating contents and pieces of equipment for which intended.
3. Deliver spare parts at same time as pertaining equipment. Deliver to Owner after completion of work.

C. Receiving:

1. Inspect and inventory items upon delivery to site.
2. Store and safeguard equipment, material and spare parts in accordance with manufacturer's 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.
3. Unload, haul, and store items.
4. Pay demurrage charges if failed to promptly unload items.
5. Assume responsibility for equipment, material and spare parts just before unloading from carrier at site.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Whipps, Inc., Athol, MA.
- B. Rodney-Hunt Co., Orange, MA.
- C. Waterman Industries, Exeter, CA.
- D. Or acceptable equivalent product.

2.2 SERVICE CONDITIONS

- A. Stainless steel sluice gate sizes and other pertinent data are included in the gate schedules on the drawings.

2.3 GENERAL

- A. All gates produced by a single manufacturer and designed for installation in the structures as indicated on the drawings.

2.4 GATE ASSEMBLIES

- A. Type: self-contained, rising stem unless otherwise specified.
- B. Leakage not to exceed 0.025 gpm per foot of seal perimeter.
- C. Unless otherwise specified, all stainless steel parts, including fasteners shall be type 316 stainless steel.

2.5 MANUAL CRANK ACTUATORS

- A. Indicate the direction of operation.
- B. See Paragraph 2.15.

2.6 FRAMES

- A. Formed or extruded stainless steel construction consisting of guides, an invert member and a top member where top closure is required. Suitable reinforcements will be provided to resist all operating loads.
- B. The guide members, invert members and yoke members shall be constructed of formed stainless steel plate with a minimum thickness of 1/4-inch.
- C. Self-contained frames shall be provided with a support yoke for mounting the actuator.
 - 1. The support yoke shall consist of structural members welded or bolted to the extended guide members.
 - 2. The support yoke shall be located as required to provide full travel of the gate slide unless otherwise specified.
 - 3. The yoke shall be designed so that the maximum deflection is limited to 1/360th of the span when operating at maximum specified head.
 - 4. For gates with powered actuators, the yoke shall be designed to limit the maximum yoke stress to 18,000 PSI at operator stall.
- D. Frames that are attached with epoxy doweled anchor bolts shall be provided with bolts conforming to ICBO report 4285 regarding number of bolts, size, and placement.

2.7 SEALS

- A. The frames shall be equipped with seats/seals to prevent metal-to-metal contact and restrict leakage.
 - 1. The guides of all gates shall incorporate ultra high molecular weight polyethylene (UHMW) seat/seals on both the upstream and downstream sides of the gate slide. Each seat/seal will be shaped to act as both a bearing surface and a seal. The top seal, where required on upward opening gates, shall be mounted on the frame and be of low friction polymer construction.
 - 2. All upward opening gates shall contain a replaceable, flush bottom neoprene invert seal, mounted on the slide.
 - 3. All downward opening gates (weir gates) shall have low friction polymer seals mounted on the frame member at the invert of the waterway.
 - 4. All seals shall be attached to the frame with stainless steel retainers and/or stainless steel bolts.
 - 5. To minimize leakage, seal-to-slide pressure shall be adjustable by means of frame mounted wedges, which do not impinge the waterway opening.

2.8 SLIDES

- A. Stainless steel construction, reinforced with angle, channel, or plate stiffeners as required to limit the deflection at maximum specified head to 1/320 of the span or 1/16" whichever is smaller.
- B. All structural component shall have a material thickness of 1/4".
- C. Stem connectors shall consist of two vertical members welded to the slide. Each stem shall be bolted to the stem connector with two stainless steel attachment bolts.
- D. Edge of slide shall be 1/2" thick minimum.

2.9 STEMS

- A. The entire stem shall be from solid stainless steel rod.
- B. The stem shall have a minimum diameter of 1-1/2".
- C. The threaded portion of the stem shall have rolled or machine cut acme threads polished to a 63 micro inch finish.

- D. The stem shall be of a size to safely withstand without buckling or permanent distortion the stresses induced by normal operating forces.
- E. The stem shall be designed to transmit in compression at least 2.5 times the output of the manual actuator with an 80 lb. effort or 1.43 times the stall thrust on electric motor actuators.
- F. A field adjusted threaded cast aluminum stop collar shall be provided on all stems with manual actuators to limit downward travel of the slide.
- G. A field-adjusted aluminum split collar upstop shall be provided on all submerged gates and weir gates to limit the upward travel of the slide.
- H. The maximum L/r ratio for the unsupported portion of the stem shall not exceed 200.

2.10 STEM GUIDES

- A. Provide integral frame mounted stem guides to limit the L/r ratio of the operating stem to 200 or less.
- B. Stem guides shall be bronze bushed and adjustable in two directions.

2.11 STEM COVERS

- A. All rising stem stainless steel sluice gates shall be provided with clear lexan or butyrate stem covers.
- B. The stem covers shall be properly vented and closed at the top with a plastic cap.
- C. The stem covers shall be provided with field mounted mylar travel indicator strips.

2.12 ANCHOR BOLTS

- A. Provide Type 316 stainless steel, epoxy doweled anchor bolts.
- B. Provide anchor bolts of no less than 1/2" diameter.
- C. Provide all anchor bolts with ample cross section to withstand the force created by operation of the gate.
- D. Install anchor bolts per manufacturer's instructions.

2.13 WALL THIMBLES (Not Used)

- A. Wall thimbles shall be a heavy one-piece stainless steel 316L construction of the type indicated on the gate schedule and shown on the contract drawings. Depth of the thimble shall be the same thickness as the wall.

Minimum material thickness shall not be less than 3/16". All parts of wall thimble including the gussets and stiffeners shall be stainless steel 316L. The vertical centerlines shall be clearly marked at top and bottom to permit alignment of the front face into vertical plane.

- B. Wall thimbles shall be internally braced during concrete placement to prevent warping. Square thimbles shall be provided with holes in the invert to allow satisfactory concrete placement beneath the thimble, and shall be on centers of 24" or less. A suitable mastic or gasket shall be used to form a seal between the front face of the thimble and the back of the gate frame. "E" type thimbles shall have the back flange drilled for mounting to pipe flange.

2.14 PAINTING

- A. All cast iron and carbon steel parts shall be completely shop primed and painted. Field painting, other than touch up, shall not be required.

2.15 MANUAL ACTUATORS

- A. The actuator shall be as shown in the Contract Drawings, provided that the effort to operate does not exceed a 40 lb. pull when the gate is subjected to the maximum unbalanced head.
- B. All manual actuators will be enclosed in a high strength cast aluminum or cast iron housing with a bronze operating nut.
- C. Non-Geared Handwheel Actuators
 1. Roller-type bearings shall be provided above and below the operating nut.
 2. Mechanical seals shall be provided above and below the operating nut.
 3. The handwheel shall have a minimum diameter of 15" and a maximum diameter of 24".
- D. Geared Crank Actuators
 1. Gearboxes shall have a 1" minimum diameter stainless steel pinion shaft.
 2. Roller-type bearings shall be provided above and below the operating nut.
 3. Mechanical seals shall be provided on the top and bottom of the

actuator housing and around the pinion shaft.

4. All gears are to be steel or bronze.
5. The crank shall have a minimum radius of 12" and a maximum radius of 15".

E. Interconnected Actuators

1. All stainless steel sluice gates 72" wide or larger or those with widths greater than twice their height shall be provided with two stems and two gearboxes connected by an aluminum or stainless steel interconnecting shaft for simultaneous operation via crank.
2. Gates shall also be equipped with dual actuators if deemed necessary for proper operation by the gate manufacturer.

F. Remote Actuator Drives (Not Used)

1. Remote actuator drives shall be provided in cases where the centerline of the handwheel (mounted on non-gearred actuator) will be located 48" or greater from the operating floor, where the centerline of the handwheel (mounted on geared actuator) will be 54" or greater from the operating floor, or where the centerline of the crank will be located 48" or greater from the operating floor.
2. Remote drives shall be of the chain and sprocket type with an aluminum cover.
3. Remote drives shall be used in conjunction with geared crank actuators. The centerline of the crank shall be positioned 30" above the operating floor.

2.16 SHOP TESTS

- A. Shop testing shall be performed. Before final assembly, all seating and wedging surfaces shall be cleaned thoroughly of all foreign materials and final adjustments made. With the gate fully assembled and closed, the clearance between seating faces shall be checked with a 0.0040-inch thickness gauge. If the thickness gauge can be inserted between seating faces, the wedging devices shall be readjusted or the gate slide or gate frame or both shall be remachined until insertion is no longer possible. In the event of remachining, clearances shall be checked again as stated above.
- B. After completion, all seating and wedging surfaces shall be cleaned thoroughly of all foreign materials, and final adjustments shall be made.

The stainless steel sluice gate shall then be shop operated from the fully closed to the fully open position to verify that the assembly is workable.

- C. Operate floorstands and benchstands to insure proper assembly and operation.

PART 3 - EXECUTION

3.1 GENERAL

- A. It shall be the Contractor's responsibility to handle, store, and install the gate, actuator mechanism, stem, stem guides, and accessories in accordance with the manufacturer's drawings, installation manual and recommendations. Care shall be taken to avoid warping the gate frame and to maintain tolerances between seating faces. All gates, stems, and actuators shall be plumbed, shimmed, bolted and aligned accurately. All gates shall be installed in a dry environment and in strict accordance with manufacturer's published instructions.
 - 1. Chemical Adhesive anchors for attaching stainless steel sluice gate components to wall material are specified.
- B. Prior to installation, protect stored gates and appurtenances from damage due to exposure to sunlight, heat, dirt, debris, freezing and thawing, vandalism, etc.
 - 1. Store gates and appurtenances in accordance with manufacturer's written recommendations.
- C. Clean debris, dirt, and gravel, from inside of gates and channels before placing gates.
- D. Install stainless steel sluice gates in completely assembled condition with discs wedged lightly but firmly into seats with nuts pulled up tight.
- E. Erect and support gates in respective positions free from distortion and strain on appurtenances during handling and installation.
- F. Inspect material for defects in workmanship and material.
- G. Clean out debris and foreign material from gate opening and seats, test operating mechanisms to check proper functioning, and check nuts and bolts for tightness. Repair, gates and other equipment that does not operate easily or are otherwise defective.

3.2 FLOORSTAND OPERATORS AND STEM GUIDES

- A. Set floorstand operators and stem guides so stems run smoothly in true alignment. Anchor guides firmly to walls. Check distances from centerlines of gates to operating level or base of floorstand and adjust if necessary to suit actual conditions of installation.

3.3 ACCEPTANCE TESTS

- A. After installation of equipment, and after completion of the services of manufacturer's representative as stated in Section 01735, operate each gate to demonstrate its ability to operate smoothly and without jamming.
- B. Leakage Test:
 - 1. Seating Heads: Leakage not to exceed 0.025 gpm per foot of seating perimeter.
 - 2. Unseating Heads: Leakage not to exceed 0.025 gpm per foot of seating perimeter.
 - 3. Conduct tests at heads shown in the gate schedule.
- C. Correct or replace defects and defective equipment at no additional compensation.

3.4 FIELD TOUCH-UP

- A. After installation and testing of stainless steel sluice gates and approval of Engineer, provide field touch-up to all damaged and abraded surfaces. Engineer to determine surfaces to receive field touch-up.
- B. Touch-up coating shall be similar to type, color and mil thickness applied in shop application.

3.5 CONTRACT CLOSEOUT

- A. Provide in accordance with Section 01700.

END OF SECTION 11282

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 11300

CHEMICAL METERING PUMPS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.
- B. Refer to Electrical Drawings for loop diagrams and other additional requirements.

1.02 WORK INCLUDED

- A. Furnish, install, test, and place in satisfactory operation, chemical feed equipment and accessories as indicated and specified.
- B. Furnish the chemical metering pump complete in all details and before acceptance, make the systems fully operational and ready for use by the Owner.

1.03 DESCRIPTION

- A. Each pump shall be positive displacement diaphragm type, complete with drive motor, gear ratio assembly, pump head assembly and chemical head assembly with attached connection fittings as specified.
- B. Pumps shall be capable of 24-hour continuous duty, dry self-priming, capable of being run dry without damaging effects to pump.
- C. Pump shall be capable of operating in either direction without output variation.

1.04 SUBMITTALS

- A. Submit in accordance with SECTION 01300.
 - 1. Certified shop drawings.
 - 2. Characteristic performance curve showing flow rate as a function of stroke length and pressure.
 - 3. Dimensional drawings.
 - 4. Operating, maintenance, programming, and wiring instructions

B. Operation and Maintenance Manuals in accordance with SECTION 01730.

1.05 DELIVERY, STORAGE, & HANDLING

A. Shipping

1. Ship pump and drive assembled complete
2. Pack all additional spare parts in containers bearing labels clearly designating contents and pieces of equipment for which intended.
3. Deliver spare parts at the same time as pertaining equipment.

B. Receiving

1. Contractor to inspect and inventory items upon delivery to site.
2. Contractor to store and safeguard equipment, material, instructions, and spare parts in accordance with manufacturer's written instructions.

PART 2 PRODUCTS

2.01 PUMP MANUFACTURER

A. Chemical Metering Pumps

1. The chemical metering pumps shall be Pulsar Series model 25HJ pumps as manufactured by Pulsafeeder of Rochester, New York.
2. No other manufacturers will be acceptable.

2.02 PUMP PROCESS SCHEDULE

Quantity	3
Tag Number(s)	CMP-1, CMP-2, CMP-3
Fluid	Calcium Nitrate solution (trade name Bioxide)
Viscosity	
Specific Gravity	1.49
Fluid Temperature Range	55 – 95 deg. F
Rated Capacity (GPH)	6.2
Rated Pressure (PSIG)	100 psi
Motor RPM for Application	1750
NPSHA	3 psi
Power (VDC)	90DC

2.03 CHEMICAL FEED PUMP

A. Specifications

1. The chemical feed pump is to be of the hydraulically balanced diaphragm type, wherein a volume measuring piston reciprocates within a cylinder and causes hydraulic oil to deflect a flat diaphragm. A diaphragm actuated, cartridge design hydraulic performance valve shall function to replenish hydraulic fluid as required, thus realigning the diaphragm to a precision controlled start point for each stroke. The pump shall be able to withstand closed suction or discharge valves without damage to the internals of the pump. Due to the high preventative maintenance requirement, incompatibility of potentially wetted parts, and limited pressure capability, peristaltic tubular or hose pumps of any kind shall not be acceptable as an alternate for the specified Pulsar pump. Peristaltic tube, peristaltic hose, and progressing cavity pumps shall not be accepted
2. Pumps shall be mechanical lost motion type flow control where a cam driven by the worm gear actuates a reciprocating piston to drive the hydraulically actuated diaphragm. Pumps utilizing hydraulic bypass lost motion shall not be accepted.
3. The pump shall include a hydraulics diagnostics package, which shall provide instant visual indications of normal hydraulic operations, system over-pressure, diaphragm integrity and proper oil level. The hydraulic bypass valve shall be externally accessible for easy adjustment.

4. Pump shall be equipped with an automatic air bleeder and a manually actuated hydraulic purge valve that can be used to validate air-free hydraulics, or so that diaphragm integrity can be easily verified without pump disassembly.
5. The pump shall be designed to full metric compliance and is available with English or Metric process connections of threaded or flanged design. If flanges are required, they shall be of one-piece construction integral to the tie bar assembly for PVDF and metal construction or socket welded construction for PVC materials. Flanges that are threaded into the existing pump threaded connections are not acceptable.
6. The metered liquid will enter the reagent head at the bottom and exit at the top through gravity seating ball-type valves. These three-component valves shall be free-seating type with valve seats having knife-edge contact and will be 4-point guided to accurately control vertical and sideward movement. Spring-loaded check valves will not be acceptable. Valve and seat will be individually replaceable and sealed by o-ring or flat gasket. Valve assemblies will not incorporate any threading other than the process pipe connection. Valves must be serviceable without removing piping. Cartridge valve assemblies are not acceptable.
7. The chemical metering head shall include a four-bolt tie bar design, which resists connection forces and helps promote leak-free performance.
8. If PVC liquid ends are to be used, the valve guides shall be molded in CLEAR (translucent) PVC material and shall include four flutes to keep the ball moving in an efficient manner. This shall allow the owner the ability to see the ball valve movement while the pump is running.
9. The diaphragm shall be a PTFE faced composite design with integral o-ring. The diaphragm shall be capable of sealing under full head-bolt torque limits without stressing the diaphragm.
10. Manual capacity adjustment by changing piston stroke length from 0 to 100% shall be accomplished while idle or operating. An auto-lock system for the manual (handwheel) stroke length control mechanism shall be provided, as standard, to prevent drift. The large, handwheel shall be pressed down and shall provide detented indication of stroke length adjustment with resolution of $\pm 0.1\%$.
11. The pump shall incorporate non-vented gear box and eccentric designs to protect the pump from the ingress of water, dirt, sand or other debris. A rotary type lip seal arrangement shall positively seal and separate the two oils of the gear box and the eccentric box. A reciprocating seal will be unacceptable. The gear box shall be filled with a heavy duty gear oil and the eccentric box shall be filled with a hydraulic oil to provide the best environment of

operation for the hydraulic system.

12. The worm and eccentric shaft shall be supported by ball bearings for long life. The eccentric shaft shall be a non-axially loaded, one piece design. The main input speed reduction shall be accomplished via a precision cut DYNALLOY gear and hardened steel worm shaft.
13. The pump shall be provided with a C-face motor, able to be mounted in one of three positions -- vertically, 45 degree angle or horizontally, dependent upon the space constraints. The C-face motor mounting arrangement shall eliminate the exposure to rotating couplings. Coupling enclosure must be totally enclosed and part of the motor mounting assembly. The motor shall be capable of operating in a clockwise or counterclockwise direction without impact on pump performance or components.
14. Pump design shall be modular type to allow for easy access to, and interchangeability of, assemblies or components. The gear reduction unit shall be capable of being mounted on either side of eccentric box.
15. Pumps shall have the ability to be duplexed in either in-line or opposed configurations.
16. The pump shall have a five year drive train warranty.
17. Flow adjustment shall be from 0 to 100% with a guaranteed accuracy of $\pm 1/2\%$ steady state on set point over a 10:1 flow turndown range.
18. The pump shall be capable of pumping with a net positive suction head available as low as 3 psi.
19. The hydraulically balanced diaphragm metering pumps shall be manufactured by Pulsafeeder, A Unit of IDEX Corporation, Rochester, New York, USA and shall be the PULSAR Model 25HJ Pump.

B. Spare Parts:

1. Supply one spare parts kit from the pump manufacturer consisting of the following:
 - a. One (1) diaphragm
 - b. Two (2) Ball Valve
 - c. Two (2) sets of valve seats
 - d. Six (6) sets of O-rings
 - e. One (1) gallon of oil.

2.04 ADDITIONAL COMPONENTS

A. Piping

1. Piping shall be schedule 80 PVC. Piping size to be coordinated with pump manufacturer.

B. Isolation valves to be PVC diaphragm valves with seals compatible with sodium bisulfite transmission.

C. Unions shall be schedule 80 PVC.

1. Seals shall be FKM or EPDM.

D. Flow Indicator

1. Shall be in the discharge side of the piping system to provide a visual indication of fluid movement through the system.
2. The flow indicator body shall be machined from clear cast acrylic with a ceramic ball indicator and PVDF ball stop.
3. The flow indicator shall be secured to the piping system with PVC connectors and polypropylene half unions.

E. Back Pressure Valve

1. Back pressure valve shall be located on the discharge side of the piping system on the pump injection piping to prevent the back flow of fluid through the system.
2. Back pressure valve shall be PVC with a 10-150 PSI pressure adjustment by Griffco or equal.
3. The maximum inlet working pressure shall be 375 PSI.

F. Pulsation Dampener

1. Pulsation dampener shall be located on the discharge side of the piping system on the pump injection piping to insure smooth continuous fluid flow.
2. Pulsation dampener shall be PVC with rubber bladder and Hypalon elastomers by Blacoh Fluid Control or equal.
3. The maximum working pressure shall be 150 PSI.

G. Ball Valves

1. Ball valves shall be located on the suction and discharge side of each chemical feed pump system provide pump isolation.
2. Ball valves shall be provided to isolate the pump for maintenance and draining fluid from the pump. Applicable seals to be compatible with calcium nitrate solution.

H. Pressure Relief Valve

1. Valve to be located on the discharge side of the piping system to prevent excessive pressure in the system. Fluid shall be returned to the inlet side of the system if the pre-set maximum system pressure is exceeded.
2. The valve shall be PVC with a PTFE diaphragm seal manufactured by Griffco Valve, Inc.
3. The pressure adjustment screw and lock nut shall be polypropylene.
4. Infinite adjustment increments from 10 to 150 psi shall be possible.
5. An outlet safety vent port shall be provided with 1/8" F/NPT connection.

I. Inlet Strainer

1. Strainer shall be on the suction side of the piping system.
2. The Y-type strainer shall be PVC with removable screen (1/32" mesh) manufactured by Hayward Flow Control Systems or equal.

J. Calibration Cylinder

1. Calibration cylinder shall be on the inlet side of the system to permit metering pump output volume calibration.
2. Valves shall permit the cylinder to be filled by gravity by bypassing the chemical metering pump output to the cylinder.
3. The PVC cylinder shall be manufactured by Griffco Valve, Inc. or equal with PVC end caps.
4. An outlet vent shall be provided.
5. Calibration cylinder size shall be 16 GPH (500 mL).

K. Pressure Gauge with Guard

1. Pressure gauge shall be on the discharge side of the system to indicate system pressure.

2. The liquid filled gauge shall be stainless steel and include a blow-out plug manufactured by McDaniel or equal.
3. The gauge shall be bottom mounted to the guard with ¼” NPT stainless steel threads.
4. The temperature compensated oil filled gauge guard shall be PVC.
5. Pressure range of gauge shall be 0-150 PSI.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Contractor shall install items in accordance with manufacturer's printed instructions and as indicated and specified.
- B. Contractor to supply piping, couplings and fittings to complete the chemical feed system.
- C. Contractor shall supply shielded signal wiring for wiring of the required remote input and output to the connectors.

3.02 WARRANTY

- A. Chemical metering pump components shall be guaranteed from failure for a period of five (5) years from the date of final acceptance. Warranty coverage shall include repair or full replacement of such failed components, or the pump assembly itself at no additional cost to the Owner.

END OF SECTION

SECTION 11310

SEWAGE PUMP AND APPURTENANCES

PART 1 GENERAL

1.01 SUMMARY

- A. Furnish, install, test and place into satisfactory operating condition Dry Pit Immersible sewage pumps, each designed for pumping raw wastewater with minimum spherical diameter solids passage of 3”.

1.02 RELATED WORK

- A. Division 1 – General Requirements
 - 1. Section 01665 – Services of Manufacturer’s Representatives
 - 2. Section 01710 – Startup
 - 3. Section 01730 – Operations and Maintenance Manual
 - 4. Section 01750 – Spare Parts
 - 5. Section 01751 – Lubricants
- B. Division 9 - Finishes
- C. Division 13 - Instrumentation
- D. Division 15 - Mechanical
- E. Division 16 - Electrical Work

1.03 DESIGN REQUIREMENTS

- A. The Work shall include all accessories, and appurtenances necessary to make a complete system. Work shall conform to requirements for installation, materials, and equipment approvals of state, local, Underwriters' Laboratories, Inc., or other applicable codes, whether or not called for in detail on the drawings or in these specifications.
- B. All openings, internal passages, and internal recirculation ports shall be large enough to permit the passage of a sphere 3" in diameter, and any trash or stringy material which may pass through the average house collection system. Screens or any internal devices that create a maintenance nuisance or interfere with priming and performance of the pump shall not be permitted.
- C. Pumps and motors shall be capable of operating in a continuous non submerged condition in vertical position in a dry pit installation, permanently connected to inlet and outlet pipes. Pumps and motors shall be of immersible construction and will continue to operate satisfactorily should the drywell be subjected to flooding.

- D. Certified dimensional drawings indicating size and locations of the priming recirculation port or ports shall be submitted to the Engineer prior to shipment.
- E. New pumps shall be capable of performing under the following operating conditions:

Worcester Road Pump Station*
3-Pumps

Pumps	Capacity (gpm)	TDH (ft)	Motor Horsepower	Speed (RPM)	Min Eff	Shut-off Head (ft)
Single Pump Operation	2,700	54	75 ¹	1170	68%	99
Parallel Pump Operation	3,500 ²	70	Operating condition for each pump			

- 1: Motors rated 460 volts, 3 phase, Inverter duty rated.
- 2: Combined two pump parallel flow. Each pump shall provide 1,750 gpm.

- F. The pumping units shall be designed to pump raw domestic sewage and discharge into a forcemain.

1.04 QUALITY ASSURANCE

- A. Pumps shall be the product of a single manufacturer with a minimum of ten years experience with equipment of the size and type specified operating in a similar arrangement.
- B. Equipment and accessories shall be the standard cataloged products of the manufacturer except as otherwise specified or indicated.
- C. Pump manufacturer to provide the pump, pump motor, pump base, suction elbow and appurtenances regardless of the manufacturer, as a complete and integrated package to insure proper coordination and compatibility of equipment.

1.05 SHOP TESTS

A. Motor Tests

- 1. Motor factory shop tests shall be in accordance with IEEE Standard 112, Appendix A, plus the factory's standard routine tests for the specified motor horsepower.

B. Pump Tests

- 1. Certified Performance Tests: Conduct performance tests on each pump and motor unit to determine head, capacity, speed, and brake horsepower at not less than six points on the operating curve including rating point and best efficiency point. Test

data shall be sufficiently comprehensive to produce guaranteed performance curves showing head versus capacity, efficiency, and brake horsepower for the rated speed. Engineer shall be supplied with the complete test procedure in advance of the testing. Test shall be witnessed and certified by a professional Engineer.

2. Hydrostatic Pressure Tests: Conduct hydrostatic pressure tests on each pump.
3. Demonstrate that all equipment is capable of continuous operation in satisfactory manner without mechanical or electrical defects or operational difficulties under suction and discharge conditions.
4. Repeat tests, if necessary, until results are obtained satisfactory to the Engineer.
5. Correct or replace all defects or defective equipment revealed by or noted during tests at no additional cost to the Owner.
6. Conduct all tests in accordance with the latest standards of the Hydraulic Institute.
7. If the specified tests indicate the pump or motor will not meet the specifications, the Engineer has the right to require complete tests for all pumps and motors at no additional cost to the Owner.

1.06 REFERENCES

- A. ASTM A48 - Standard Specification for Gray Iron Castings.
- B. ASTM A276 - Specification for Stainless and Heat-Resisting Steel Bars and Shapes.
- C. AFBMA
- D. Hydraulic Institute Standards.
- E. National Electrical Manufacturer's Association.

1.07 SUBMITTALS

- A. Submit to the Engineer for approval as provided in Section 01300, shop drawings showing details of construction and installation of all equipment furnished under this Section. The following shall be included:
 1. Shop drawings and materials of construction and performance of electric motors, pumps, controls, pipes, valves and fittings, equipment, conduit, wiring, wiring devices, transformer and access manhole, rails and bracket.
 2. Manufacturer's rating curves showing pump characteristics of pressure, capacity,

brake horsepower, and efficiency. This information shall be prepared specifically for the pump proposed. Catalog sheet showing a family of curves will not be acceptable.

3. Literature and drawings describing the equipment in sufficient detail, including materials of construction and parts list, to indicate full conformance with the detail specifications.
 4. Complete parts list for equipment furnished.
 5. Motor data such as HP, Volts, RPM, FLC, Efficiency, and p.f. as described herein.
 6. Complete wiring diagrams and schematics of all controllers, control panels, control devices, and operators furnished under this Section.
 7. Complete wiring diagrams and schematics of all power and control systems.
 8. Floor plans, sections and elevations showing a complete layout to scale of all equipment, piping, electrical conduits and wall sleeve installation locations and methods to provide watertight seals.
 9. Motor wiring diagrams for power and high temperature switches.
 10. Services of manufacturer's representative and warranties.
 11. Drawings and calculations indicating pipe support material, locations, and engineering data of support scheme.
 12. Refer to the Contract Drawings for the pumps' inlet and upstream wetwell configuration, suction piping, and discharge piping and provide written confirmation by a qualified Professional Engineer registered in the Commonwealth of Massachusetts that the supplied pumps are capable of reliable performance at the specified operation conditions without excessive vibration or cavitation.
- B. In the event that it is impossible to conform to certain details of the specifications due to different manufacturing techniques, describe completely all non-conforming aspects for review and approval by the Engineer.
- C. Submit under provisions of Section 01300.
- D. Pump and Motor Characteristics and Performance Data:
1. Provide guaranteed certified performance curves based on actual shop tests of mechanically duplicate pumping units, showing they meet specified requirements

for capacity, head, horsepower, efficiency, and NPSH. For units of same size and type, provide curves for a single unit.

2. Catalog performance curves at required speed showing maximum and minimum impeller diameters available.
- E. Manufacturer's written warranty.
- F. Shop Test Results: Provide six (6) certified copies and one (1) electronic copy of pump performance test data, pump performance curves, hydrostatic test results and motor test results.
- G. Field Inspection Reports: Submit under provisions of Section 01700.

1.08 OPERATION AND MAINTENANCE INSTRUCTIONS

- A. Provide operation and maintenance instructions as specified in Section 01730. Note, both "Paper" and "Electronic" manuals are required.

1.09 DELIVERY, STORAGE, AND HANDLING

- A. Ship equipment, material, and spare parts complete except where partial disassembly is required by transportation regulations or for protection of equipment.
- B. Pack spare parts in containers bearing labels clearly designating contents and pieces of equipment for which intended.
- C. Deliver spare parts at same time as pertaining equipment.
- D. Inspect and inventory items upon delivery to site and provide Engineer with inventory list.
- E. Store and safeguard equipment, material, and spare parts in accordance with manufacturer's instructions and deliver to Owner after completion of the work.

1.10 WARRANTY

- A. Manufacturer shall fully warrant the pumps and motors to the Owner against defects and workmanship and materials for a period of **five (5) years** under normal use and service. If any pump part, including the motor requires replacement, the part shall be replaced at no charge to the Owner. **All costs for parts and labor that are required to complete a qualifying repair shall be included in the warranty.**

A copy of each warranty shall be provided to the Owner at start-up.

PART 2 PRODUCTS

2.01 ACCEPTABLE PUMP MANUFACTURERS

- A. Smith & Loveless, Inc.
- B. No other manufacturers will be acceptable

2.02 PUMP CONSTRUCTION

- A. The pumps shall be 8" vertical, non-clog type of heavy cast iron construction, especially designed for the use of mechanical seals. To minimize seal wear caused by linear movement of the shaft, the shaft bearing nearest the pump impeller shall be locked in place so that end play is limited to the clearance within the bearing. To minimize seal wear resulting from shaft deflection caused by the radial thrust of the pump, the shaft from the top of the impeller to the lower bearing supporting the impeller shall have a minimum diameter of 1-7/8" for motor frame sizes 213 through 286; 2-1/8" for motor frame sizes 324 and 326; and 3" for frame 364 and larger. The dimension from the lowest bearing to the top of the impeller shall not exceed 6".
- B. Impeller: The impeller shall be of the Non-Clog Two-Port type. The pump impeller shall be of the enclosed two-port type made of close-grained cast-iron and shall be balanced. The eye of the impeller as well as the ports shall be large enough to permit the passage of a sphere 3" in diameter in accordance with nationally recognized codes.

The impeller shall be keyed with a stainless-steel key and secured to the motor shaft by a stainless-steel cap screw equipped with a Nylock or another suitable self-locking device. The impeller shall not be screwed or pinned to the motor pump shaft and shall be readily removable without the use of special tools.

To prevent the buildup of stringy materials, grit and other foreign particles around the pump shaft, all impellers less than full diameter shall be trimmed inside the impeller shrouds. The shrouds shall remain full diameter so that close minimum clearance from shrouds to volute is maintained. Both the end of the shaft and the bore of the impeller shall be tapered to permit easy removal of the impeller from the shaft.

- C. Volute: The pump volute shall be of heavy cast iron construction free from projections that might cause clogging or interfere with flow through the pump. The volute casing shall be double volute to reduce radial thrust.
- D. Mechanical Seal: The pump shaft shall be sealed against leakage by a double mechanical seal installed in a bronze seal housing constructed in two sections with registered fit. The housing shall be recessed into the pump backhead and securely fastened thereto with stainless steel cap screws. The inside of the seal housing shall be tapered to facilitate the replacement of the seal parts. The seal shall be a double

seal with the mating surfaces lapped to a flatness tolerance of one light band. The rotating member shall be held in mating position with the stationary carbons by a stainless-steel spring. The seal housing with assembled parts shall be so constructed as to be readily removable from the shaft as a unit and shall be provided with tapped jackscrew openings to assist in removing it from the backhead.

- E. Mechanical Seal Protection System: The seal shall be pressurized and lubricated by water taken directly from the pump backhead. The water shall pass through a filter to the seal housing and be introduced between the upper and lower sealing surfaces. The filter shall be of corrosion-resistant materials and shall screen out all solids larger than 50 microns. The seal system shall contain a brass valve connected near the top of the seal housing to permit the relief of any air trapped in the seal unit. A manually operated brass valve shall also be provided to vent the pump volute.
- F. Pump Shaft: The shaft shall be solid 316 stainless steel through the mechanical seal to eliminate corrosion and abrasive rust particles. Removable shaft sleeves will not be acceptable if the shaft under the sleeve does not meet the specified minimum diameter.
- G. Pump Bearings: The bearing nearest the impeller shall be designed for the combined thrust and radial load. The upper bearing shall be free to move linearly with the thermal expansion of the shaft and shall carry only radial loads.
- H. Pump Support: Each pump shall be secured to a steel support stand attached to cast concrete support pad of suitable strength to support the weight of the pump and resist any expected torsion, bending, or vibration forces.

2.03 MOTORS

- A. The pump motors shall be vertical, solid shaft, NEMA P base, squirrel cage induction type, suitable for 3 phase, 60 cycle, 460 volt electric current. They shall have Class F insulation, suitable for temperatures up to 105 degrees C. Insulation temperature shall, however, be maintained below 80 degrees C.
- B. The motors shall have normal starting torque and low starting current, as specified by NEMA Design B characteristics. They shall be Open Top, Drip Proof (ODP) design with forced air circulation by integral fan. Openings for ventilation shall be uniformly spaced around the motor frame as is applicable to the motor type required.
- C. Leads shall be terminated in cast connection box and shall be clearly identified.
- D. The motors shall have 1.15 service factor. The service factor shall be reserved for the Owner's protection. The motors shall not be overloaded beyond their nameplate rating, at the design condition, nor at any head in the operating range as specified under Operating Conditions.

- E. The motor pump shaft shall be centered, in relation to the motor base, within .005". The shaft run out shall be limited to .003".
- F. The motor shaft shall equal or exceed the diameter specified under Pump Construction 2.02.A of this section, at all points from immediately below the top bearing to the top of the impeller hub.
- G. A bearing cap shall be provided to hold the bottom motor bearing in a fixed position. Bearing housings shall be provided with fittings for lubrication as well as purging old lubricant.
- H. The motor shall be fitted with heavy lifting eyes or lugs, each capable of supporting the entire weight of the pump and motor.
- I. The pump motors shall be Premium Efficiency type, per NEMA MG-1 table 12-12, Inverter Ready per NEMA Part 31.4.4.2, with cast-iron frames, and be UL Recognized and CSA Approved. The motor windings shall be 200 C Inverter Spike-Resistant magnet wire and the rotors shall have an epoxy coating for corrosion protection.
- J. The pump motors shall be of immersible type capable of running immersed in up to 30-feet of water for a period of up to three weeks without water entering the cavity.
- K. A power cord 50-feet in length shall be provided with each pumping unit.

2.05 PAINTING

- A. All structural carbon steel and cast-iron surfaces shall be factory blasted with steel grit, in an environmentally controlled booth, to remove rust, mill scale, weld slag, etc. All weld spatter and surface roughness shall be removed by grinding.
- B. Surface preparation and cleanliness shall comply with SSPC-SP6 specifications.
- C. The surface profile shall be 2.0 mils (0.05 mm). Sandblasting is specifically prohibited. After blast cleaning, all surface contaminants, such as grease or oil, shall be removed before coating.
- D. Immediately following cleaning, a single 6 mil (0.15 mm) minimum dry film thickness coating of VERSAPOX®, a self-priming Cycloaliphatic Amine Epoxy shall be factory applied. This coating shall be as formulated by Smith & Loveless, Inc.® specifically for this type of application and service.
- E. Finish coating shall be accomplished prior to shipment of the equipment from the factory and shall comply fully with the intent of these specifications. A touch-up kit shall be provided by the equipment manufacturer for repair of any marks or scratches

occurring during shipping and installation. This kit shall contain detailed instructions for use.

- F. Stainless steel, aluminum and other corrosion-resistant surfaces shall not be coated. Carbon steel surfaces not otherwise protected shall be coated with a suitable non-hardening rust preventative compound.
- G. Ferrous surfaces obviously not to be painted shall be given a shop coat of grease or other suitable rust-resistant coating.
- H. Coatings damaged in shipment or installation shall be cleaned to white metal and touched up in the field with the same materials as original coatings.

2.06 CONTROLS

- A. Pumping System Control Panel shall be provided under Division 17 – Instrumentation.
- B. Pump manufacturer shall provide and deliver stator winding thermal sensor relays for each pump to the Contractor for incorporation into the motor controllers.

2.07 MISCELLANEOUS

- A. Manufacturer shall provide a dolly designed to maneuver the pumps above grade.
 - a) The dolly shall be designed to allow maintenance personnel to move pump from point of installation to hatch for extraction.
 - b) The dolly shall be sized to carry the weight of the proposed pump with a 1.5 factor of safety.
 - c) The dolly shall be provided with flat free tires.
 - d) The dolly shall also include measures to secure the pump in place during transport.
- B. Submit design for Engineer's review.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install items in accordance with manufacturer's instructions.
- B. Install pumping units in the bottom floor of the dry well structure and provide supports as required.
- C. After alignment is correct, grout as specified in Section 03300.
 - 1. Fill entire base and leave no gaps or voids.

2. Do not embed leveling nuts in grout.

3.02 MANUFACTURER'S FIELD SERVICES

- A. Provide services of factory trained service engineer with a minimum of five (5) years' experience to assist in location of anchor bolts; setting, leveling, field erection, etc.; and coordination of piping, electrical and miscellaneous utility connections. Provide in accordance with Section 01665.
- B. Provide services of manufacturer's representative as specified in Section 01665.
- C. Provide operation and maintenance training as specified in Section 01665.

3.03 FIELD TESTING

- A. Refer to Section 02149 Maintaining Existing Flow to coordinate bypass pumping system with installed new pumps during field testing and startup.
- B. Certified Performance Tests: Conduct performance tests on each pump to determine head, capacity, speed, and brake horsepower at not less than six points on the operating curve including rating point and best efficiency point. Test data shall be sufficiently comprehensive to produce guaranteed performance curves showing head versus capacity, efficiency, and brake horsepower for the rated speed.
- C. Hydrostatic Pressure Tests: Conduct hydrostatic pressure tests on each pump.
- D. The Contractor shall conduct a running pump test for a minimum of 4 hours, in the presence of the Engineer. The test shall indicate that the pumps conform to the head and capacities specified. The contractor/supplier shall field measure the pump's operating voltage, starting amperes and running amperes including the pressure/flow readings with 0%, 25%, 50%, 75% and 100% discharge valve positions.
- E. The Contractor shall provide both factory and field acceptance testing of the Variable Frequency Drives, RVNR Starters, I&C pumps control and alarm panels as specified in Division 17.
- F. A 14-day operating period of the pumps will be required before acceptance. If pump performance does not meet the Specifications and shop drawing submittals, the Contractor shall take corrective measures or the pumps shall be removed and replaced with pumps that satisfy the conditions specified at no additional cost to the Owner. The decision of the Engineer shall be final.
- G. The manufacturer shall furnish the services in the presence of the Engineer, of a qualified factory representative for a minimum of 8 hours to confirm the completed pump installation to be satisfactory. Compensation for such services shall be paid for by the Contractor.

- H. The pump supplier, after successfully completing the pumps and I&C panels field testing, shall issue a letter of certification on the equipment's installation and operation with regards to its acceptability for its warranty.
- I. Pump tests include all I & C testing. Test will include the testing of all associated controls.
- J. The pump motors shall also be field tested by the Contractor's NETA Testing Firm for acceptance prior to being placed into service.

3.04 SPARE PARTS

- A. Furnish one set of all special tools required for the proper servicing of all equipment supplied under these Specifications, packed in a suitable steel tool chest with a lock. Special tools shall include any tools not available in ordinary hardware stores.
- B. Furnish the manufacturer's standard set of spare parts including at least the following:
 - Three (3) complete set of gaskets and O-rings
 - Three (3) mechanical seals
 - Three (3) Spare volute gaskets
 - Three (3) complete replacement pump shaft seal assemblies
 - Three (3) spare filter elements
 - Three (3) spare cooling fans and shear pin
 - Three (3) spare seal housings
 - One (1) set of all specialty tools required for maintenance and repair of the pump

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 11400

POLYETHYLENE CHEMICAL STORAGE TANKS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. This specification covers upright, single wall, high density polyethylene storage tank assemblies for chemical storage, including the Bioxide storage tanks.
- B. **Items in this specification section are subject to the American Iron and Steel requirements of P.L. 113-76, the Consolidated Appropriations Act of 2014**

1.02 RELATED SECTIONS

- A. SECTION 01300 – SUBMITTALS
- B. SECTION 01730 – OPERATION AND MAINTENANCE MANUALS
- C. SECTION 11300 – CHEMICAL METERING PUMPS
- D. SECTION 17300 – INSTRUMENTATION AND CONTROL SYSTEM

1.03 REFERENCES

- A. ASTM D618 – Conditioning Plastics and Electrical Insulating Materials for Testing
- B. ASTM D638 – Tensile Properties of Plastics
- C. ASTM D790 – Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
- D. ASTM D883 – Definitions of Terms Relating to Plastics
- E. ASTM D1505 – Density of Plastics by the Density-Gradient Technique
- F. ASTM D1525 – Test Method for Vicat Softening Temperature of Plastics
- G. ASTM D1693 – Test Method for Environmental Stress-Cracking of Ethylene Plastics
- H. ASTM D1998 – Standard Specification for Polyethylene Upright Storage Tanks
- I. ASTM D2765 – Degree of Crosslinking in Crosslinked Ethylene Plastics as Determined by Solvent Extraction
- J. ASTM D2837 – Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials
- K. ASTM D3892 – Practice for Packaging/Packing of Plastics
- L. AATM F412 – Definitions of Terms Relating to Plastic Piping Systems
- M. ARM (Association of Rotational Molders) Low Temperature Impact Resistance (Falling Dart Test Procedure)

- N. ANSI B-16.5 Pipe Flanges and Flanged Fittings
- O. OSHA 29 CFR 1910.106 Occupational Safety and Health Administration, Flammable and Combustible Liquids

1.03 SUBMITTALS

- A. Shop Drawings in accordance with specification Section 01300.
- B. **Certification of compliance with the American Iron and Steel requirements of P.L. 113-76, the Consolidated Appropriations Act of 2014, is required with all submittals.**
- C. Submit to the Engineer shop drawings showing details of construction and erection for each tank as follows:
 - 1. Dimensions of tank, fittings, and attachments, with bolt and gasket material.
 - 2. Locations of fittings and attachments and size of manway openings.
 - 3. Wall thickness calculations for each tank. Calculations shall be per ASTM D 1998-99 using 600 PSI design hoop stress @ 100° F.
 - 4. Resin used and a complete manufacturers specification of the resin use.
 - 5. Knuckle radius.
 - 6. Weight of tank.
 - 7. Corrosion data for all materials in contact with the chemicals.
 - 8. Certificate of Compliance stating:
 - i. All fittings, insulation, et cetera, have been installed by the tank manufacturer.
 - ii. H₂O tests have been performed by the manufacturer and all fittings were installed prior to H₂O tests.
 - iii. All tanks are designed and manufactured in accordance with ASTM-D 1998 Type 1.
- D. Operation and Maintenance Manual in accordance with specification Section 01730.

1.04 MARKING, DELIVERY, STORAGE, AND HANDLING

- A. In accordance with specification Section 01600.
- B. The tanks shall be marked to identify the product, date (month and year) of manufacture, capacity, and serial number. The tank shall be shipped with a bar code label containing tank description, manufacturing order number, part number, serial number, manufacturer, and date.
- C. The proper caution or warning signs as prescribed by OSHA standard 29 CFR 1910.106 shall be customer determined and supplied.

- D. All packing, packaging, and marking provisions of ASTM Practice D3892 shall apply to this standard. Tank shall be wrapped in polyethylene to protect it from dirt, grease, oil, etc. during shipping and storage.
- E. Customer specified labeling shall be available.
- F. Tank shrink wrapping and bagging shall available upon customer request.
- G. All fittings shall be installed, removed, and shipped separately.

PART 2 PRODUCTS

2.01 GENERAL

- A. Tanks shall be rotationally molded, vertical, high density cross-linked polyethylene, one-piece seamless construction, cylindrical in cross-section and vertical with flat bottoms. Tanks shall be marked to identify the manufacturer; date of manufacture and serial numbers must be permanently embossed into the tank.

2.02 MANUFACTURERS

- A. Chem-Tainer Industries, Inc. W. Babylon, NY
- B. Poly Processing Company Monroe, LA
- C. Snyder Industries, Inc., Lincoln, Nebraska
- D. Approved equal.

2.03 CHEMICAL COMPATIBILITY

- A. Tanks shall be capable of storing Bioxide.
- B. Chemical compatibility shall be according to the following chemical resistance guides:
 - 1. Pruett, Kenneth M., "Chemical Resistance Guide for Elastomers", Compass Publications.
 - 2. Pruett, Kenneth M., "Compass Corrosion Guide II", Compass Publications.
- C. Construction
 - 1. All tanks shall be:
 - a. Type I – molded from Cross-linked Polyethylene Resin

2.04 MATERIALS

- A. The tank shall be molded from Grade I high density cross-linked polyethylene with an integral, internal lining molded from oxidation resistant polymer. The resin shall be Poly CL or equal, as manufactured by Exxon/Mobil Chemical Company with the anti-oxidant resistant liner being OR-1000 or approved equal.

B. All polyethylene resin material shall contain a minimum of a UV-8 stabilizer as compounded by the resin manufacturer. Pigments shall not exceed 0.25% (dry blended) of the total weight.

C. Mechanical Properties of Type I tank material:

<u>PROPERTY</u>	<u>ASTM</u>	<u>VALUE</u>
Density (Resin)	D1505	0.938-0.946 g/cc
Tensile (Yield Stress 2"/min)	D638	3290 PSI
Elongation at Break (2"/min.)	D638	640%
ESCR (100% Igepal, Cond. A, F50)	D1693	>1000 hours
ESCR (10% Igepal, Cond. A, F50)	D1693	>1000 hours
Vicat Softening Degrees F. Temperature	D1525	248
Flexural Modulus	D790	88,700 PSI

2.05 TANK DESIGN

- A. The tanks shall be designed for above-ground, vertical installation and be capable of containing chemicals at atmospheric pressure.
- B. The tanks shall be designed for 1.9 Specific Gravity using a hoop stress value of no greater than 600 psi at 100° F, with a safety factor of no less than 2, using the Barlow Formula for calculating wall thickness. For applications in excess of 100° F design conditions, lower values for the design hoop stress shall be used.
- C. All edges cut out for manway or other openings shall be trimmed to have smooth edges.
- D. The finished surface shall be as free as commercially practical from visual defects such as foreign inclusions, air bubbles, pin holes and craters.
- E. The knuckle radius at bottom to wall shall be a minimum of 1". The minimum thickness of the radius shall not be less than the maximum thickness of the cylinder wall.

2.06 DIMENSIONS AND TOLERANCES

- A. All dimensions will be taken with the tank in the vertical position, unfilled. Tank dimensions will represent the exterior measurements.
 - 1. The tolerance for the outside diameter of the primary tank, including out of roundness, shall be per ASTM D1998.
 - 2. The tolerance for fitting placements shall be +/- 0.5 in. in elevation and 2 degrees radial at ambient temperature.

2.07 TEST METHODS

A. Test Specimens

- 1. Test Specimens shall be taken from fitting location areas or piggy-back test molds.

B. Low Temperature Impact Test

1. Test specimens shall be conditioned at -40 degrees Fahrenheit for a minimum of 2 hours.
2. The test specimens shall be impacted in accordance with the standard testing methods as found in ASTM D1998. Test specimens < 1/2" thickness shall be tested at 100 ft.-lb. Test specimens > 1/2" thickness shall be tested at 200 ft.-lb.

C. Degree of Crosslinking Test

1. The test method used is to be the o-xlene insoluble fraction (gel test) per ASTM D2765 Method C. This test method is for determination of the ortho-xlene insoluble fraction (gel) of crosslinked polyethylene.
2. The percent gel level on the inside 1/8 in. of the wall shall be a minimum of 60%.

D. Ultrasonic Tank Thickness Test

1. All tanks 2000 gallons or larger shall be measured for tank wall thickness at 6", 1ft., 2ft. and 3ft. on the tank sidewall height at 0° and 180° around the tank circumference with 0° being the tank manway and going counter-clockwise per ANSI standard drafting specifications. A copy of this test report can be ordered when placing the original tank order. All tanks shall meet design thickness requirements and tolerances.

E. Hydrostatic Water Test

1. The hydrostatic water test shall consist of filling the tank to brim full capacity for a minimum of four hours and conducting a visual inspection for leaks. A hydrostatic water test will be conducted if ordered by the customer.

2.08 WORKMANSHIP

- A. The finished tank wall shall be free, as commercially practicable, of visual defects such as foreign inclusions, air bubbles, pinholes, pimples, crazing, cracking and delaminations that will impair the serviceability of the vessel. Fine bubbles are acceptable to the degree in which they do not interfere with proper fusion of the resin melt.
- B. All cut edges where openings are cut into the tanks shall be trimmed smooth.

2.09 TANK FITTINGS

A. DOME FITTINGS

1. All dome fittings shall be flanged Universal Ball Dome style. There shall be a single 150 Lb. ANSI PVC flange with a 1/4" gasket attached to the outside tank wall. The flange shall be bolted to the tank from the inside with a minimum of four (4) 1/2" diameter all thread bolts with bolt heads encapsulated in polyethylene. The encapsulation shall be a minimum 2" in diameter x .75" thick and fully cover

the bolt head and a minimum of ¼" of the threads closest to the bolt head. Each bolt shall have a ¼" gasket which is on the inside of the tank. All dome fittings shall be fume tight. Bolts and gaskets shall be as specified in the tank data sheet.

B. VENT FITTINGS

1. The vent shall be installed by the tank manufacturer and sized in accordance with 2.11 A.

C. SIDE WALL FITTINGS FOR TANK OUTLET, DRAIN AND/OR OVERFLOW FITTING

1. Outer tank drain fitting shall be bolted flange style. There shall be a single 150 Lb. ANSI PVC flange and a ¼" gasket attached to the outside tank wall. The flange shall be bolted to the tank from the inside with a minimum of four (4) ½" diameter all thread bolts with bolt heads encapsulated in polyethylene. The encapsulation shall be a minimum 2" in diameter x .75" thick and fully cover the bolt head and a minimum of ¼" of the threads closest to the bolt head. Each bolt shall have a ¼" gasket which is on the inside of the tank. Bolts shall be 316 stainless steel and gaskets shall be with material specified for storage.

2.10 TANK ATTACHMENTS

A. TIE DOWN SYSTEM

1. Tank restraint system shall be designed by a Structural Engineer registered in the State of Massachusetts. Design shall conform to the most recent edition of the IBC code for seismic load.

B. ULTRASONIC LEVEL INDICATOR

1. In accordance with specification Section 17300.

2.11 TANK ACCESSORIES

A. MANWAY AND VENT

1. The manway openings for tanks shall be a minimum of 24" and have a combination type manway cover. Covers shall be 16-bolt and have a 10" coarse threaded cover with a push plate and XLPE gasket. The cover shall have two (2) XLPE foam gaskets and the bolts shall be polyethylene.
2. Each tank must be properly vented for the type of material and flow rates expected. Vents must comply with OSHA 1910.106 (F) (iii) (2) (IV) (9) normal venting for atmospheric tanks or other accepted standard or shall be as large as the filling or withdrawal connection, whichever is larger but in no case less than 1 in. nominal inside diameter.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install the tank in accordance with the drawings and the manufacturer's instructions.
- B. Install the process piping in such a manner which allows the tank to expand and contract when filled and drained, as per the manufacturer's recommendation. All piping must be supported in accordance with the pipe manufacturer's recommendations. The expansion joint shall isolate the tank from the rest of the piping.
- C. Upon successful completion of the field test, tanks and support members shall be anchored in their final position according to the manufacturer's recommendations.

3.02 FIELD TESTING

- A. After installation, each tank shall be field tested by filling with water. The tank and fittings shall hold water without loss, evidence of weeping or capillary action for a period of 24 hours prior to acceptance.

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 11550

ODOR CONTROL SYSTEM

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Furnish, install and test dual media bed odor control system.
- B. These Specifications are intended to give a general description of what is required, but do not cover all details that will vary in accordance with the requirements of the equipment furnished. They are, however, intended to cover the furnishing and delivery of all materials, equipment and appurtenances for the odor control system herein specified, whether specifically mentioned in these Specifications or not.
- C. Related Sections: The following sections contain requirements that relate to this Section:
 - 1. Division 01 – General Requirements
 - 2. Section 03000 – Cast-In-Place Concrete
 - 3. Section 11961 – Interior and exterior Process Piping
 - 4. Section 16050 – Motors-Electrical
 - 5. Section 16900 – Electrical-Miscellaneous Equipment
 - 6. Section 17300 – Instrumentation and Controls

1.3 WARRANTY

- A. All equipment supplied under this Section of the Specifications shall be warranted for a period of one (1) year from date of shipment.
- B. The equipment shall be warranted to be free from defects in workmanship, design, and materials. If any part of the equipment should fail during the warranty period, it shall be repaired or replaced and the unit (s) restored to service at no expense to the Owner.

1.4 DESCRIPTION OF SYSTEM

- A. The Manufacturer shall furnish complete, odor control system. The manufacturer of the system shall be responsible for the design and fabrication of the complete system within the limits specified herein. Site preparation shall be the responsibility of the Contractor as described and as specified.

The following minimum design parameters shall be incorporated into the manufacturer's design:

Influent concentration:

Blower Horsepower: 3 HP

Airflow Rate: 1,000 scfm

Vapor Phase Catalytic Carbon: Dual Canister (230 pounds total)

1.5 QUALITY ASSURANCE

- A. To assure unity of responsibility, all equipment and material specified in this Section of the Specifications shall be furnished and coordinated by the odor control system manufacturer.
- B. The equipment covered by these Specifications shall be standard equipment of proven ability as manufactured by reputable manufacturers having long experience in the production of such equipment. The manufacturer shall supply the engineer with details of previous installations. The equipment furnished shall be designed and constructed in accordance with the best practice and methods and shall operate satisfactorily when installed.
- C. All equipment furnished under this Specification shall be new and unused and shall be the standard product of manufacturers having a successful record of operation, manufacturing, and servicing similar equipment and systems. The biofiltration systems shall be as manufactured by Biocube, Inc. of Victor, NY, or equal.

1.6 SUBMITTALS

- A. Copies of all materials required establishing compliance with the specifications shall be submitted to the Engineer in the form of a booklet or binder. Submittals shall be prepared specifically for this project. Standard, preprinted sheets or drawings marked to indicate applicability to this contract will not be acceptable. Submittals shall include at least the following.
1. Plan view drawing showing arrangement of treatment units and yard piping.
 2. List of addresses and phone numbers of owners of units using the proposed treatment arrangement and equipment for verification purposes of operation and maintenance considerations.

3. Product drawings and cutsheets, descriptive literature, bulletins and catalogs on all equipment including but not limited to the following.
 - a. Odor Control system performance and operating characteristic data sheet.
 - b. Detailed physical drawings of the treatment units to include all external piping connections and associated sizes, and materials of construction.
 - c. The manufacturers standard installation, operation and maintenance manual.
 - d. Documentation of experience with at least five other similar installations, and at least one published case study of a similar application.
 - e. Qualifications of manufacturer's technical service representative.
- B. List all exceptions taken to the specification along with backup documentation as to why the exception has been taken. In the event that it is impossible to conform to certain details of the Specifications due to different manufacturing techniques, describe and justify completely all non-conforming aspects.

1.7 FIELD SUPPORT

- A. A representative of the Manufacturer who has complete knowledge of proper operation and maintenance shall be provided to instruct representatives of the Owner on proper operation and maintenance. This work may be conducted in conjunction with the inspection and the installation and test run as provided under Part 3 - Execution. If there are difficulties in operation of the equipment due to the Manufacturer's design or fabrication, additional service shall be provided at no cost to the Owner.

1.8 PRODUCT HANDLING

- A. All equipment items shall be properly protected so that no damage or deterioration will occur from the time of shipment until installation is completed and the units and equipment are ready for operation.
- B. Proper care shall be taken to protect mechanical parts from the entrance of water during shipment, storage, and handling.
- C. Each box or package shall be properly marked to show its contents.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All equipment furnished shall be new and suitable for the conditions of service to which they will be subject. Workmanship shall be of the highest quality and shall

be carried out by competent and experienced workmen. All parts shall be protected so that no damage may occur during a long delay from time of shipment to time of completion of installation.

- B. The odor control system shall contain vapor phase catalytic activated carbon, 4x8 mesh, high activity with H₂S capacity of 0.20 grams of H₂S per cubic centimeter of carbon.
- C. The airflow capacity shall be 1000 CFM.
- D. Contractor is responsible for all flexible connections and piping.
- E. Discharge air outlet shall be provided with rain hood and bird screen.

2.2 MATERIALS

- A. The odor control system shall be skid mounted with all components provided by one manufacturer.
- B. Carbon bed shall consist of two (2) 55-gallon steel drums with quick connection for carbon change out.
- C. The system shall be supplied with a weather shroud.

2.4 PROCESS STREAM PIPING

- A. All piping, pipe fittings, piping supports and other related supplies shall be provided by the Contractor and installed in accordance with the Engineer's and Manufacturer's recommendations.
- B. The materials of construction for all non-metallic piping, fittings and valves shall contain UV inhibitors.

2.5 BLOWER/FAN SECTION

- A. Provide 1,000 cfm of flow.
- B. Provide 3 horsepower 3 Phase 230/460 motor.
- C. Centrifugal type flanged suction direct drive, 3,450 rpm, TEFC motor.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Installation by the Contractor of each equipment item shall be in strict accordance with the respective Manufacturer's and Engineer's instructions and

recommendations in the locations shown on the drawings. All costs for the installation shall be the responsibility of the Contractor.

3.2 INSPECTION, START-UP, AND OPERATOR TRAINING

- A. A manufacturer's representative who is familiar with the operations, startup procedures and troubleshooting of the systems shall be present to perform inspection, start-up, and operator training services for the system in accordance with Section 01665. The Engineer shall review the qualifications of the technical service representative. The approved manufacturer's representative shall schedule training with the Owner.

3.3 CONTRACT CLOSEOUT

- A. Provide in accordance with Section 01700.

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

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.

1.02 RELATED SECTIONS

- A. Section 09900 – Painting

1.03 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. 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.

1.04 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 MATERIALS

A. 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. 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.

2.02 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.

2.03 SHOP PAINTING

- A. Pipe support components shall be shop and finish coated prior to installation.

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. 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.
 - F. 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.
 - G. 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.

3.03 PVC PIPING. The installation of PVC pipe for 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.

3.04 PAINTING

- A. All piping shall be painted in accordance with specification Section 09900 – Painting.

3.05 CONTRACT CLOSEOUT

- A. Provide in accordance with Section 01700.

END OF SECTION

DIVISION 14

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 14600

HOISTING EQUIPMENT

PART 1 GENERAL

1.1 WORK INCLUDED

- A. Furnish, install, test and place in satisfactory operation the hoisting equipment, complete with all supports, fastenings, and other appurtenances, as indicated on the Drawings and as herein specified.
- B. The Specifications and Drawings direct attention to certain required features of the equipment but do not purport to cover all details entering into its design and construction. Nevertheless, the Contractor shall furnish, shop test, deliver, install and field test all materials, equipment and appurtenances for the hoisting equipment complete in all details and ready for operation as specified herein, whether specifically mentioned in these Specifications or not.

1.2 RELATED WORK

- A. Division 1 – General Requirements
- B. Division 5 - Metals
- C. Division 9 - Finishes
- D. Division 11 - Equipment
- E. Division 15 – Mechanical
- F. Division 16 – Electrical

1.3 QUALITY ASSURANCE

- A. The hoisting systems shall conform to the location, capacity, critical dimensions and other pertinent data listed in the “Equipment Schedule” included herein.
- B. All structural steel members of the handling system shall be designed in accordance with the specifications of American Institute of Steel Construction, current edition, and any welded construction shall be in accordance with the standards of the American Welding Society.

- C. Castings, forgings, stampings, etc., shall have a safety factor of at least 5.
- D. Provide service of factory train service technician with training specific to the hoisting equipment provided.
 - 1. Provide service of manufacturer's representative as specified in Section 01665

1.4 Submittals

- A. Product Data: For each type of product indicated.
- B. Maintenance Data: For each product to include in maintenance manuals.
- C. Warranties: As specified in the General Conditions.

PART 2 PRODUCTS

2.1 GENERAL

- A. All hoisting equipment shall conform to the current standards set forth by the following:
 - 1. Hoist Manufacturers Institute - HMI 100, HMI 200 and HMI 400.
 - 2. American National Standard Institute ANSI B30.11, ANSI B30.16 and ANSI C1.
 - 3. American Institute of Steel Construction
 - 4. American Welding Society
 - 5. Crane Manufacturers Association of American Inc., (C.M.A.A.).
 - 6. Occupational Safety and Health Administration (O.S.H.A.)
- B. All hoisting equipment parts shall be proportioned so that all stresses and vertical or lateral deflections will be within conservative limits with minimum vibration. Rated load safety factors of at least five, based upon ultimate strength of the materials used, shall be employed.
- C. The Contractor shall verify all dimensions and clearances in the field prior to erection of the hoisting equipment and shall be responsible for the proper fitting and operation of the equipment.
- D. The capacity of each hoist and trolley shall be permanently marked in a conspicuous manner.
- E. Safety Devices: Comply with applicable safety codes, as directed by local authority having jurisdiction, and as follows.
 - 1. Equip with end stops to limit movement of trolley.
 - 2. All hooks shall be safety type.

- F. Align structural beam with the monorail; determine hanger locations according to loading requirements.

2.2 ACCEPTABLE MANUFACTURERS

- A. Motor Operated Hoist: Hoisting equipment shall be manufactured by Yale Hoisting Equipment Division,; Shaw Box, ACCO-Wright, or be an acceptable equivalent product.

2.3 EQUIPMENT

A. Motor Operated Hoist

1. System shall be equipped with a four button, push button operator with ballast resistors to cushion the start. Push Button Station shall be NEMA 4X.
2. Hooks shall be of high grade, forged steel, and shall have swivel, antifriction bearings.
3. Power cord length specified is based on required travel distance. Additional cord shall be provided based on manufacturer’s requirements.

B. EQUIPMENT SCHEDULE

Hoist Location	Lower Level	Upper Level
Number Required	1	1
Rate Use	Indoor	Indoor/Outdoor
Clearance Req.	Low Headroom	Low Headroom
Suspension Type	Hook	Hook
Capacity	2 Ton	2 Ton
Lifting Speed	20 ft/min variable	20 ft/min variable
Hoist Type	Motorized Wire Rope	Motorized Wire Rope
Distance from Hook to Operating Floor	12 feet	32 feet
Trolley	Motorized	Motorized
Travel Distances	28 feet	34 feet
Power	460V, 3-phase, 60 Hz	460V, 3-phase, 60 Hz
Hoist HP	2	2
Trolley HP	0.5	0.5

C. Pushbutton Control

1. The control provided shall have sufficient buttons to control all functions of the hoist and trolley operations.
2. Each button shall be clearly marked with its function.
3. The control cable shall be long enough to reach within 4-feet of the operating level. Provide support arm if required so controls will be kept readily available to the operator.

D. Safety Stops

1. Safety stops shall be provided for both ends of the trolley tracks. The stops shall be capable of safely stopping the trolley and hoist when in motion under full load.

E. Cable Reels

1. Power cable for the electric hoist and trolley shall be a self-winding spring operated reel installed at the approximate midpoint of travel. The reel shall have a fixed base and roller outlet

F. Fasteners

1. Studs, nuts, washers, and fasteners shall be Type 304 stainless steel and shall be furnished with the hoisting equipment.

2.4 PAINTING

- A. Primer and Finished Paint: All steelwork and machinery except bearing surfaces, shafts, chain, cable, and stainless steel shall be painted. Surfaces to be painted shall be thoroughly dry and free from rust, grease or dirt. Primer and high solids epoxy shall be shop applied.

- B. Ferrous surfaces obviously not to be painted shall be given a shop coat of grease or other suitable rust-resistant coating.

- C. Field painting as specified in Section 09900 - Painting.

PART 3 EXECUTION

3.1 INSTALLATION

- A. All equipment shall be installed in accordance with the manufacturer's written instructions, as approved, and all equipment and materials required for proper installation shall be provided.

- B. It shall be the responsibility of the Contractor to coordinate the work included under this section of the specifications with other related work specified herein to insure that all the equipment shall operate to perform the designated functions in a proper and acceptable manner.

- C. Anchor bolts, expansion bolts, studs, nuts, washers and fasteners shall be set as per manufacturer's recommendations.

3.2 ADJUSTING

- A. Adjust hoists to operate smoothly under all load conditions, without malfunction.

3.3 FIELD ACCEPTANCE TESTS

- A. Test hoists, at the rated load, in the presence of the Engineer.
- 3.4 TOOLS AND LUBRICANTS
- A. Furnish a complete set of any special tools required for the maintenance and operation of this equipment, as designated by the equipment manufacturer.
 - B. A one-year supply of each type of lubricant required for each piece of equipment and one grease gun for each type of lubricant required shall be furnished under this Section.

END OF SECTION

DIVISION 15

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 15050

PIPE PENETRATIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Requirements for furnishing and installing pipe penetration assemblies. This Section covers materials for various pipe penetration configurations. Refer to the Contract Drawings for details of assembly and for location.

1.02 REFERENCES

- A. American Society for Testing and Materials (ASTM)
 - 1. ASTM A53, Standard Specification for Pipe, Steel, Black, and Hot-Dipped, Zinc-Coated, Welded and Seamless.
- B. American National Std. Institute (ANSI)/American Water Works Assoc. (AWWA)
 - 1. ANSI/AWWA C151/A21.51, Ductile Iron Pipe, Centrifugally Cast in Metal Molds or Sand Lined Molds for Water or Other Liquids

1.03 SUBMITTALS

- A. Submit to in accordance with SECTION 01300, manufacturers' literature on all items to be furnished, installation instructions, and where applicable, fire rating and certified test results of the various components.

PART 2 PRODUCTS

2.01 PIPE SLEEVES

- A. Unless otherwise shown all pipe sleeves shall be Schedule 40 galvanized steel pipe conforming to ASTM A53. Provide a 2-in minimum circumferential water stop welded to exterior of sleeve at its midpoint. Ends of sleeves shall be cut, ground smooth, and shall be flush with the wall or ceiling and extend 2-in above finished floors. Sleeves required to be sealed by caulking shall be sized as required. Sleeves required to be sealed with mechanical seals shall be sized in accordance with the seal manufacturer's recommendations, and shall be a single seal for wall thicknesses up to and including 12-in; two mechanical seals shall be provided for wall thicknesses greater than 12-in. Sleeves for insulated piping shall be sized to accommodate the approved insulation.

2.02 WALL CASTINGS

- A. Unless otherwise shown, wall castings shall be ductile iron conforming to ANSI/AWWA C151/A21.51, thickness Class 53, diameter as required. Flanges and/or mechanical joint bells shall be drilled and tapped for studs where flush with the wall. Castings shall be

provided with an intermediate ½-in thick by 2-in minimum circumferential flange/waterstop, integrally cast with or welded to the casting, located such that it falls within the middle third of the wall.

2.03 SEALING MATERIALS

- A. Mechanical seals shall be modular, adjustable, bolted, mechanical type consisting of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and sleeve. The seal shall be rated by the manufacturer for 40 feet of head or 20 psig. Mechanical seals shall be Link-Seal, manufactured by Thunderline Corp., Wayne, MI., or equal.
- B. Sealant shall be a two part foamed silicone elastomer as manufactured by Dow Corning Co., product No. 3-6548 silicone R.T.V.; 3M brand fire barrier products caulk C.P. 25 and 3M brand putty 303; or Flame-Safe fire stop systems Fig. No. FS-500 by Thomas & Betts Corporation. Packing shall be a fire retardant pliable material, Fig. 310 by Sealtite Co., White Oakum W.S.-600 by American Manufacturing Co., or equal. Sealant bead configuration, depth and width shall be in accordance with manufacturer's recommendations.

2.04 MISCELLANEOUS MATERIALS

- A. Bonding compound shall be Sikadur Hi-Mod epoxy by Sika Corporation, equal by Euclid Chemical Corporation; Master Buildings Company or equal.
- B. Non-shrink grout shall be Masterflow 713 by Master Builders Company, Euco N-S by Euclid Chemical Co.; Five Star Grout by U.S. Grout Corp. or equal.
- C. Galvanized escutcheon plates shall be provided for all exterior sleeved wall penetrations above finished grade.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Assemble and install components of pipe penetration assemblies as detailed in the Contract Documents.

END OF SECTION

SECTION 15070

DUCTILE-IRON PIPE AND FITTINGS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes

1. Requirements to furnish, install, joint, and test ductile-iron pressure pipe, fittings (including special castings), and appurtenant materials and equipment indicated on the Drawings and specified in this Section.
2. This Section covers Ductile-Iron Piping not buried in earth.
3. **Items in this specification section are subject to the American Iron and Steel requirements of P.L. 113-76, the Consolidated Appropriations Act of 2014.**

B. Related Sections

1. Section 09900 – Painting
2. Section 15140 – Pipe Hangers and Supports

1.02 REFERENCES

A. American National Standards Institute (ANSI)

1. A21.10, Standard for Gray-Iron and Ductile-Iron Fittings, 3-inch. through 48-inch., for Water and Other Liquids.
2. A21.11, Standard for Rubber-Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings.
3. A21.15, Standard for Flanged Cast-Iron and Ductile-Iron Pipe with Threaded Flanges
4. A21.50, Standard for Thickness Design of Ductile-Iron Pipe.
5. A21.51, Standard for Ductile-Iron Pipe, Centrifugally Cast in Metal Molds, or Sand-Lined Molds, for Water or Other Liquids.
6. B16.1, Standard for Ductile Iron Pipe Flanges and Flanged Fittings.

B. American Water Works Association (AWWA)

1. C606, Standard for Grooved and Shouldered Joints.

C. American Society for Testing Materials (ASTM)

1. A307, Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.

1.03 SUBMITTALS

A. In accordance with SECTION 01300 submit the following:

B. Shop Drawings

1. Piping layouts in full detail.
2. Location of pipe hangers and supports.
3. Location and type of backup block or device to prevent separation.
4. Large scale details of all wall penetrations and special castings.
5. Schedules of all pipe, fittings, special castings, couplings, expansion joints, and other appurtenances.

C. Certificates

1. Sworn certificates in duplicate of shop tests showing compliance with appropriate standard.

D. Manufacturer's Literature

1. Catalog cuts of joints, couplings, harnesses, expansion joints, gaskets, fasteners and other accessories.
2. Brochures and technical data of coatings and lining's and proposed method of application.

1.04 QUALITY ASSURANCE

A. Inspect and test at foundry according to ANSI Standards.

B. Owner reserves right to inspect and/or test by independent service at manufacturer's plant or elsewhere at his own expense.

C. Owner reserves right to perform visual inspection and hammer test before installation.

PART 2 PRODUCTS

2.01 PIPE

A. Ductile-Iron Pipe

1. Designed in accordance with ANS A21.50.

2. Manufactured in accordance with ANS A21.15 or ANS A21.51.
3. Ductile-iron pipe shall be at least thickness **Class 52** for pipe 4-inch. and smaller and at least thickness **Class 53** for pipe 6-inch. and larger, unless stated otherwise.
4. Ductile-iron pipe for use with split couplings shall have a thickness as specified in this Section.

B. Pipe For Use With Couplings

1. Pipe for use with split couplings shall be as specified above except that the ends shall not have bells or beads but shall have cast or machined shoulders or grooves conforming to AWWA C606.

2.02 FITTINGS

A. Flanged Fittings

1. Provide with working pressure of 250 psi.
2. Faced and drilled in accordance with ANS A21.10 except that special drilling or tapping shall be provided as necessary to ensure correct alignment and bolting.
3. Flanged fittings which are not available under ANS A21.10 (e.g. laterals or reducing ell) shall be furnished to conform to the requirements of ANS B16.1, class 125.

B. Base Elbows

1. Fittings shall be provided with standard bases in accordance with ANSI/AWWA C110/A21.10 where so indicated.

C. Grooved Fittings

1. In accordance with ANS A21.10 in all respects except minimum wall thickness as follows:

<u>Nominal Pipe size, in.</u>	<u>Minimum wall thickness, in.</u>
3	0.40
4	0.40
6	0.45
8	0.53
10	0.55
12	0.60

D. Nonstandard Fittings

1. Fittings having nonstandard dimensions and cast especially for this project shall be of acceptable design. They shall be manufactured to meet the requirements of

the same specifications and shall have the same diameter and thickness as standard fittings, but their laying lengths and types of ends shall be determined by their positions in the pipelines and by the particular piping to which they connect.

2.03 ADAPTERS

- A. Where it is necessary to joint pipes of different type, furnish and install the necessary adapters unless solid sleeves are indicated on the drawings or permitted. Adapters shall have ends, conforming to the above specifications for the appropriate type of joint, to receive the adjoining pipe. Adapters joining two classes of pipe may be of the lighter class provided that the annular space in bell-and-spigot type joints will be sufficient for proper jointing.

2.04 JOINTS

A. Gaskets

- 1. Gaskets shall be of a composition suitable for exposure to the product which the pipe is intended.

B. Flanges

- 1. Flanges for flanged pipe shall conform to ANS A21.15 except that special drilling or tapping shall be done as necessary to ensure correct alignment and bolting.

2.05 COUPLINGS

A. Flexible Connections at Equipment

- 1. Where flexible connections in the piping are specified or indicated on the Drawings, they shall flanged end, heavy duty rubber body type specifically designed for connecting pipe to pump or similar configuration.

B. Split Couplings

- 1. Split couplings may be used for connecting ductile-iron pipe. If split couplings are used with grooved pipe, the minimum pipe wall thickness shall be as specified under AWWA C606.
- 2. Split couplings shall be made of malleable iron and shall be NAPPCO couplings made by North American Pipe Products Co.; or acceptable equivalent products.
- 3. Where split couplings are furnished in lieu of flanged joints the joint shall be of the rigid type with pipe grooves cut to bring the ends of the pipe solidly together. The beam strength of the joint shall be equal to or greater than that of a flanged joint.
- 4. Where split couplings are indicated to provide for expansion or flexibility, the pipe grooves shall be cut to provide the necessary expansion or flexibility.

2.06 ACCESSORIES

A. Filling Rings

1. Provide suitable filling rings where the layout of the flanged piping is such as to necessitate their use. In materials, workmanship, facing, and drilling, such rings shall conform to ANSI Class 125 standard.
2. Filling rings shall be of suitable length with nonparallel faces and corresponding drilling, if necessary, to ensure correct assembly of the adjoining piping or equipment.

B. Gaskets, Bolts, And Nuts

1. For flanged joints, gaskets shall be ring gaskets of rubber with cloth insertion. Gaskets 12-inch diameter and smaller shall be 1/16-inch thick; larger than 12-inch, to be 1/8-inch thick.
2. Flanged joints shall be made with bolts, bolt studs with a nut on each end, or studs with nuts where the flange is tapped. The number and size of bolts shall conform to the same American National Standard as the flanges.
3. Bolts and nuts shall, except as otherwise specified or noted on the drawings, be Grade B conforming to ASTM, A307.
4. Bolt studs and studs shall be of the same quality as machine bolts.
5. Submerged flanged joints shall be made up with Type 316 stainless steel stud bolts and nuts.

C. Tapped Connections

1. 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 the listed size in the appropriate table of the Appendix to the above-mentioned ANS A21.51 based on 3 full threads for cast iron and 2 full threads for ductile iron.
2. Where the size of the connections 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 a 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 permitted by the Engineer.
3. All drilling and tapping of cast-iron pipe shall be done normal to the longitudinal axis of the pipe; fitting 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. Wall Castings

1. Wall castings shall be of the sizes and types indicated on the drawings. Flanges, facing and drilling shall conform to ANS A21.10 except that where required, as where a flange is substantially flush with the face of a masonry wall, flanges shall be drilled and tapped for studs. Other dimensions shall be substantially equal to corresponding parts of standard fittings. A central fin not less than ½-inch thick and 1-1/2-inch to 2-inch high shall be cast on the barrel at a point that will locate it midway through the wall to form a water stop.

2.07 FINISHES

A. Lining

1. Inside of pipe and fittings shall be coated with Inderon Protecto 401 ceramic epoxy lining in accordance with the manufacturer's requirements.

B. Coating

1. The outside of pipe and fittings within structures shall not be coated with the bituminous coating, but shall be thoroughly cleaned and given one shop coat of Intertol Rustinhibitive Primer 621 made by Koppers Co., Inc., Pittsburgh, Pa.; Multiprime made by PPG Industries, Inc., Pittsburgh, Pa.; Chromox 13R50 Primer made by Mobil Chemical Co., Edison, NJ; or an acceptable equivalent product.
2. Outside surfaces of castings to be encased in concrete shall not be coated. Castings encased in concrete shall be wrapped in poly
3. Machined surfaces shall be cleaned and coated with a suitable rust-preventative coating at the shop immediately after being machined.

PART 3 EXECUTION

3.01 HANDLING

A. Pipe and Fittings

1. Care shall be taken in handling and installing pipe and fittings to avoid damaging the pipe, scratching or marring machined surfaces, and abrasion of the pipe coatings.
2. Any fitting showing a crack and any fitting or pipe which has received a severe blow that may have caused an incipient fracture, even though no such fracture can be seen, shall be marked as rejected and removed at once from the Work.
3. In any pipe showing a distinct crack and in which it is believed there is no incipient fracture beyond the limits of the visible crack, the cracked portions, if so approved, may be cut off by and at the expense of the Contractor before the pipe is installed so that the pipe used is perfectly sound. The cut shall be made in the sound barrel at a point at least 12-inches from the visible limits of the crack.

3.02 CUTTING

A. Pipe

1. Except as otherwise approved, all cutting shall be done with a machine having rolling wheel cutters, knives, or saws adapted to the purpose. Hammer and chisel or so-called wheel span cutters shall not be used to cut pipe. All cut ends shall be examined for possible cracks caused by cutting.
2. All field cuts shall be sealed in the field using Inderon Protecto 401 touch-up in accordance with the manufacturer's requirements.
3. If authorized by the Engineer damaged pipe coating shall be repaired in the field using Inderon Protecto 401 touch-up in accordance with the manufacturer's requirements. Any section of pipe with the interior coating damaged beyond repair as identified by the Engineer shall be replaced at no additional cost to the Owner.

B. Fittings

1. If authorized by the Engineer damaged interior coating of fittings shall be repaired in the field using Inderon Protecto 401 touch-up in accordance with the manufacturer's requirements. Any fitting with the interior coating damaged beyond repair as identified by the Engineer shall be replaced at no additional cost to the Owner.

3.03 INSTALLATION

A. Pipe and Fittings

1. No defective pipe or fittings shall be installed or placed in the Work, and any piece discovered to be defective after having been installed or placed shall be removed and replaced by a sound and satisfactory piece.
2. Each pipe and fitting shall be cleared of all debris, dirt, etc., before being installed and shall be kept clean until accepted in the complete work.
3. Pipe and fittings shall be installed accurately to the lines and elevations indicated on the drawings or required. Care shall be taken to ensure a good alignment both horizontally and vertically.

B. Castings

1. Castings to be encased in masonry shall be accurately set with the bolt holes, if any, carefully aligned.
2. Immediately prior to being set, castings shall be thoroughly cleaned of all rust, scale and other foreign material.

C. Appurtenances

1. All valves, fittings and appurtenances shall be set and jointed as indicated on the Drawings.

3.04 ASSEMBLING

A. Bolted Joints

1. Before the pieces are assembled, rust-preventive coatings shall be removed from machined surfaces.
2. Pipe ends, sockets, sleeves, housings, and gaskets shall be thoroughly cleaned and all burrs and other defects shall be carefully smoothed.

B. Flanged Joints

1. Flanged joints shall be made up tight, care being taken to prevent undue strain upon pump nozzles, valves, and other pieces of equipment.

3.05 PIPING SUPPORT

A. In accordance with Section 15140.

B. The Contractor shall furnish and install all supports necessary to hold the piping and appurtenances in a firm, substantial manner (as determined and/or directed by the Engineer) at the lines and grades indicated on the drawings or specified. The design and fabrication of such supports shall be the responsibility of the Contractor as part of the work.

C. All pipe and appurtenances connected to equipment shall be supported in such a manner as to prevent any strain being imposed on the equipment. When manufacturers have indicated requirements that piping loads shall not be transmitted to their equipment, the Contractor shall submit a certification from the manufacturer stating that such requirements have been complied with.

D. Piping within buildings and structures shall be adequately supported from floors, walls, ceilings and beams. Supports from the floor shall be by approved saddle stands or suitable concrete or brick piers as indicated or approved by the Engineer. Pipe saddles shall be shaped to fit the pipe with which they will be used and shall be capable of screw adjustment. Concrete piers shall conform accurately to the bottom one-third to one-half of the pipe. Piping along walls shall be supported by approved wall brackets with attached pipe rolls or saddles or by wall brackets with adjustable hanger rods. For piping supported from the ceiling, approved rod hangers of a type capable of screw adjustment after erection of the piping and with suitable adjustable concrete inserts or beam clamps shall be used.

3.06 CLEANING

- A. Prior to the pressure and leakage tests, the piping shall be thoroughly cleaned of all dirt, dust, oil, grease and other foreign material. This work shall be done with care to avoid damage to linings and coatings.

3.07 PRESSURE AND LEAKAGE TESTS

- A. Except as otherwise directed, all pipelines shall be given combined pressure and leakage tests in sections of approved length.
- B. The Contractor shall furnish and install suitable temporary testing plugs or caps; all necessary pressure pumps, pipe connections, meters, gages, relief valves, and other necessary equipment; and all labor required, to test the pipe specified in this Section.
- C. Subject to approval and provided that the tests are made within a reasonable time considering the progress of the project as a whole, and the need to put the section into service, the Contractor may make the tests when he desires.
- D. However, pipelines embedded in concrete shall be tested prior to placing of the concrete and exposed piping shall be tested prior to field painting.
- E. Unless it has already been done, the section of pipe to be tested shall be filled with water of approved quality, and all air shall be expelled from the pipe. If hydrants or blow offs are not available at high points for releasing air the Contractor shall make the necessary taps at such points and shall plug said holes after completion of the test.
- F. The section under test shall be maintained full of water for a period of 24 hours prior to the combined pressure and leakage test being applied.
- G. The pressure and leakage test shall consist of first raising the water pressure (based on the elevation of the lowest point of the section under test and corrected to the gage location) to a pressure in pounds per square inch numerically equal to the pressure rating of the pipe but not to exceed 200 psi. Care shall be taken not to apply this pressure to items of equipment known to be incapable of withstanding such pressure.
- H. If the Contractor cannot achieve the specified pressure and maintain it for a period of one hour with no additional pumping, the section shall be considered as having failed to pass the test.
- I. If the section fails to pass the pressure and leakage test, the Contractor shall do everything necessary to locate, uncover, and repair or replace the defective pipe, fitting, or joint, all at his own expense and without extension of time for completion

of the work. Additional tests and repairs shall be made until the section passes the specified test and is considered acceptable by the Engineer.

- J. If, in the judgment of the Engineer, it is impracticable to follow the foregoing procedure exactly for any reason, modifications in the procedure may be made as required and approved by the Engineer, but in any event the Contractor shall be fully responsible for the ultimate tightness of the line within the above leakage and pressure requirements.

3.08 DISINFECTING AND FLUSHING

- A. Not Required.

3.09 PAINTING

- A. The shop coats to be given pipe and fittings are specified under article 2.06 FINISHES.
- B. Field painting is Specified in SECTION 09900 - FIELD PAINTING.

END OF SECTION

SECTION 15100

VALVES, GATES, AND APPURTENANCES

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes

1. Requirements for furnishing and installing valves, gates, and miscellaneous piping appurtenances, as indicated on the Drawings and as specified.
2. The Drawings and Specifications direct attention to certain features of the equipment, but may not cover all the details of their design. The equipment furnished shall be designed and constructed equal to the high-quality equipment manufactured by such firms as mentioned, or as permitted by the Engineer. The Contractor shall furnish and install the equipment complete in all details and ready for operation.
3. **Items in this specification section are subject to the American Iron and Steel requirements of P.L. 113-76, the Consolidated Appropriations Act of 2014.**

B. Related Work

1. Section 09900 - Painting

1.02 DESIGN REQUIREMENTS

- ###### A. Enclosures shall be suitable for the atmosphere in which they are installed.

1.03 REFERENCES

A. American Society for Testing and Materials (ASTM)

1. A126, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
2. A536, Standard Specification for Ductile Iron Castings
3. B62, Standard Specification for Composition Bronze or Ounce Metal Castings

B. American Water Works Association (AWWA)/American National Standards Institute (ANSI)

1. ANSI/AWWA C110/A21.10, Standard for Ductile Iron & Gray-Iron Fittings 3 in through 48 in for Water and Other Liquids
2. ANSI/AWWA C111/C21.11, Standard for Rubber-Gasket Joints for Ductile-Iron and Pressure Pipe and Fittings
3. ANSI/AWWA C509, Resilient-Seated Gate Valves for Water-Supply Service
4. ANSI/AWWA C515, Reduced-Wall, Resilient-Seated Gate Valves for Water-Supply Service
5. ANSI/AWWA C517, Resilient-Seated Cast-Iron Eccentric Plug Valves
6. ASME/ANSI B16.1/B16.5, Cast Iron Pipe Flanges and Flanged Fittings/ Pipe Flanges and Flanged Fittings
7. AWWA C550, Protective Epoxy Interior Coatings for Valves and Hydrants
8. AWWA C606, Grooved and Shouldered Joints

1.04 SUBMITTALS

A. Submit in accordance with Section 01300 – Submittals

1. Manufacturer's specifications, catalog data, descriptive matter, illustrations, diagrams etc.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- #### A. All gate, globe, angle, and check valves shall be the product of one manufacturer.

2.02 GATE VALVES

A. Valves smaller than 2-inches.

1. 200 lb. WOG minimum bronze valves with screwed ends to suit the piping in which they are installed.
2. Body material shall conform to ASTM B62.
3. Valves shall have union bonnet, rising stem, inside screw, and solid wedge gate.

B. Resilient Seat Gate Valves 2-inches and larger

1. Manufactured by American Flow Control, Birmingham AL; Kennedy Valve, Elmira, N.Y. or approved equal.
2. Gate valves shall be resilient seated wedge type in accordance with AWWA C515.
3. Ductile Iron-body, resilient-wedge or double disk as specified.
4. Mechanical joint or flanged ends as indicated on the Drawings or herein specified.
5. All valves shall be designed for a minimum of 250 psi working pressure.
6. Face-to-face dimensions of flanged valves shall conform to the ANS B16.10.
7. Stem material shall be silicon bronze or an acceptable equivalent having high resistance to dezincification.
8. All exposed nuts, bolts and washers shall be stainless steel.
9. Valves shall be capable of being repacked under line pressure.
10. Valves shall be turned to the **left (counterclockwise)** to open.
11. Coatings
 - a. Exterior and interior surfaces of all valves shall be coated by the valve manufacturer prior to shipment.
 - b. The coating shall be applied and cured in strict conformance with the coating manufacturer's cautions and instructions.
 - c. The coating shall be applied by the valve manufacturer under controlled factory conditions, and field application is strictly prohibited.
 - d. The coating shall be a fusion bonded epoxy-protective coating system which meet all requirements of AWWA C550.

C. Process Valves

1. In accordance with AWWA Specification C-500.
2. Iron body, bronze trim, solid wedge with tapered seat or double revolving disc, parallel seat construction.
3. If of the parallel seat type, the discs and wedges shall be free of pockets and rib.

D. Potable Water Valves 4-inches through 12-inches

1. Gate valves shall be resilient seated wedge type in accordance with AWWA C515.
 2. Valve bodies to be of ductile iron.
 3. All valves shall be allowed replacement of upper "O" rings while the valve is under pressure in a fully-opened position.
 4. Valves shall have a two-inch operating nut or hand-wheel as required for the particular application and as shown on the Drawings.
 5. Coating
 - a. The AWWA C550 epoxy coating shall not impart taste or odors to the water. The coating shall be a product acceptable to the NSF for use in potable water and shall be so listed in the most current NSF summary of approved products (ANSI/NSF Standard 61).
- E. Valves greater than 12-inches.
1. Shall meet the requirements of AWWA **C515** as indicated on the Drawings and meet requirements of the applicable sections of this specification.
- F. Buried/Exterior Valves
1. O-ring seals at stuffing box and bonnet to body flanges
 2. Mechanical joint ends.
 3. Non rising stem, inside-screw, two (2) inch operating nut.
 4. Suitable for buried service.
- G. Interior Valves
1. Stuffing box follower bolts shall be of steel and the nuts shall be of bronze.
 2. O.S. & Y. except where N.R.S. is called for, and have a packing seal.
 3. Flanged unless otherwise shown on the Drawings.
 4. Flanges shall be drilled to the ANSI 125/150 pound standard.
- H. Actuators
1. Means of actuation by wheel, lever, tee wrench, gear actuator or motorized actuator, as specified or as indicated on the Drawings.
 2. Interior Gate Valves
 - a. Hand-wheel operated.
 - b. Hand wheels shall be of ample size for ease of operation and shall have an arrow and the work OPEN cast thereon to indicate the direction of opening.
 - c. Chain operator for valves with operating stem height six (6) feet above finished floor.
 - d. Supply actuators to operate valve as required.
 3. Buried/Exterior Valves
 - a. Provide extension stem with two-inch operating nut, to terminate 18 inches below finish grade.
 - b. Provide valve boxes.
 - c. All buried valves shall be equipped with the specified actuator and shall be suitable for buried service.
 4. Valves 12 inches and larger
 - a. Equip with gear actuators.
 - b. 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.
 - c. Shaft bearings furnished with permanently lubricated bronze bearing bushings.
 - d. Actuator shall clearly indicate valve position and an adjustable stop shall be provided.

- e. Construction of actuator housing shall be semi-steel with exposed nuts, bolts, and washers to be zinc plated.
 - f. All valve actuators shall be as recommended by the valve manufacturer.
5. Valves shall be manufactured by American Flow Control, Birmingham, AL; Kennedy Valve, Elmira, N.Y. or acceptable equivalent.

2.03 BUTTERFLY VALVES

A. General

1. Semi-steel bodies as specified under ASTM A-126, Class B, nickel alloy iron with solid one-piece stainless steel shaft and constant contact with the disc to provide strength and rigidity.
2. Valve shall be of the lug body type for use between 125/150 ANSI flanges.
3. Shaft shall be ground and polished to minimize bearing and seal wear.
4. Packing shall be multiple ring type packing.

B. Construction

1. Valves shall have reinforced Teflon corrosion resistant bearings with phenolic back to assure smooth valve operation.
2. Valves shall have universal actuator mounting for field interchangeability.
3. 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.
4. 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.

C. Operation

1. Valves shall be operated by a means of an enclosed hand wheel.
2. 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.
3. Shaft bearings shall be furnished with permanently lubricated bronze bearings and bushings.
4. Actuators shall clearly indicate valve position and an adjustable stop shall be provided to closing torque.
5. A maximum of 18 turns shall actuate the valve from fully closed to fully open.

D. Valves shall be by DeZurik, Keystone or equal.

2.04 GLOBE VALVES

A. Valves shall have bronze body and fittings and shall be hand-wheel operated.

B. Discs shall be bronze and renewable type.

C. Valves shall be designed for 150 psi working pressure and shall have threaded connections unless otherwise specified.

D. Valves shall be by Powell, Stockham or equal.

2.05 NEEDLE VALVES

- A. Bronze bodies with screwed ends and long tapered plugs and seating surfaces suitable for close regulation of flows.
- B. In sizes up to 3/4 inches, spindles and seats shall be bronze. Valves shall be Walworth Co. No. 120; Crane Co. No. 88; Jenkins Bros., No. 741-G; or acceptable equivalent product.
- C. In sizes over 3/4 inches, tapered plug type globe or angle valves as specified shall be used.

2.06 CHECK VALVES

- A. Check valves 3 inches and larger
 - 1. Iron-body, bronze-mounted, full-opening, swing-type check valves with bolted covers and flanged ends.
 - 2. Flanges shall be faced and drilled in accordance with the 125-lb. AN Standard.
 - 3. Valves shall have bronze faced cast iron disc plate suspended at the top from a stainless steel shaft.
 - 4. Valve shaft shall be supported by bronze bushings and bearings and shall be packed through externally accessible stuffing box.
 - 5. Disc shall seat against resilient seat installed in the valve body.
 - 6. Valve closure shall be assured by means of outside lever and weight.
 - 7. Shop primed on the outside with a rust inhibitive priming system.
- B. Check valves smaller than 3-inches
 - 1. 300 pounds bronze curving design with screwed-in bonnet, regrinding bronze disc, and screwed ends.
 - 2. Disc shall be suspended at the top with a stainless steel shaft.
 - 3. All check valves shall be horizontally mounted.

2.07 ELASTOMERTIC "DUCKBILL" CHECK VALVES

- A. Valve body
 - 1. 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.
 - 2. 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.
 - 3. 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.
- B. Check sleeve
 - 1. One-piece rubber construction with fabric reinforcement.
 - 2. Inlet port shall have an integral flange, drilled to be retained by the flange bolts and acting as the gasket between pipe and valve.
 - 3. The integral 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.
 - 4. The port area shall contour down to a duckbill, which shall allow passage of flow in one direction while preventing reverse flow.

C. 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.

D. Operation

1. 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.
2. When back pressure exceeds the line pressure by at the same amount, the bills of the valve are forced closed.

E. Manufacture

1. All elastomeric “duckbill” check valves shall be Series 39 as manufactured by the Red Valve Co., Inc. of Carnegie, PA, or approved equal.

2.08 PLUG VALVES

A. General

1. Valves shall be in full conformance to AWWA C517.
2. Nonlubricated eccentric type with resilient faced plugs for service in sewage and sludge piping.
3. Valves shall provide bi-directional sealing at 175 psi differential in sizes up to 12 inches and 150 psi differential for sizes 14 inches and larger.
4. 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.
5. Valves shall be of the bolted bonnet, top entry design, capable of repacking without removing the bonnet or valve from the pipe line.
6. All exposed nuts, bolts and washers shall be stainless steel.
7. Valves shall be DeZurik Model PEF Eccentric Plug Valves, or approved equal. All valves furnished shall be by the same manufacturer.

B. End Connections

1. Flanged ends to be in full compliance with ANSI B16.1-125 lb. /ANSI B16.5 - 150 lb standards including facing, drilling and thickness.
2. Mechanical Joint ends to be in accordance with AWWA C111.
3. Grooved ends to be in accordance with AWWA C606.
4. Screwed ends to be NPT Standard.

C. Port areas

1. Unobstructed when open and have smoothly shaped waterways of not less than 100 percent of full pipe area.

D. Valve body

1. Cast iron conforming to ASTM A-126 Class B.

E. Plug

1. ASTM A536, shall be solid, one piece ductile iron with cylindrical seating surface eccentrically offset from the center of the shaft. The plug shall be resilient faced with neoprene, or other resilient material suitable for use with sewage.
2. Bearing to be sleeve type, stainless steel and be isolated from solid particulates.

F. Coatings

1. 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.
2. Epoxy coatings are also acceptable.

G. Actuators

1. Valves larger than six inches.
 - a. Provided with manual gear operators having a maximum rim pull of 80 pounds as per AWWA C-504.
 - 1) 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.
 - 2) All shaft bearings shall be furnished with permanently lubricated bronze bearing bushings. Adjustable stops shall be provided.
 - b. Provide with hand wheels.
2. Valves above six feet from the finish floor or in inaccessible locations.
 - 1) Operated by a chain operator and chain wheel provided by the valve manufacturer to operate that particular valve.
3. Valves six inches and smaller located within six feet six inches of the finished floor in accessible locations.
 - 1) Operated by a portable lever.
 - 2) One portable level shall be provided for 50 percent of the valves or 15 portable levers whichever is less.
4. Valves in inaccessible locations shall be operated by extension stem, stem guides, 2-inch operating nut with mounting bracket or floor box, or floor stand, and lever or hand wheel as appropriate.
5. The plug valve manufacturer shall provide all operator accessories as required to make each operator system completely operational.
6. Design criteria for extension stems and stem guides shall be as specified under the section title -Miscellaneous Metal Work.
7. Buried or submerged service valves
 - 1) Seals on all shafts and gaskets on the valve and actuator covers shall prevent the entry of water.
 - 2) Actuator mounting brackets for buried or submerged service shall be totally enclosed and shall have gasket seals.
 - 3) All exposed nuts, bolts, springs and washers used in buried service shall be stainless steel.
8. Actuator shall clearly indicate valve position.

2.09 KNIFE GATE VALVES

- A. 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.
- B. Valves shall be metal seated and lapped. Metal seated valves shall have a round port. Valve bodies shall have wetted parts of Type 304 stainless steel.
- C. 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.

- D. Valves two inches through 24 inches shall have a raised face seat with relieved area around the seat to prevent jamming.
- E. Unless otherwise shown or specified, stem shall have double pitch threads and be equipped with two to one ratio gear operators with hand wheels, which shall provide adequate clearance.
- F. Valves shall be by DeZurik or equal.
- G. All knife gates shall be hand wheel actuated.

2.10 BALL VALVES

A. General

- 1. Straight-through passageway and shall be of the full-port design.
- 2. Rated for 150-psi service.

B. Construction

- 1. Type 316 stainless steel, except for those valves specified PVC construction or installed in PVC piping.
- 2. Body shall be of rigid construction and symmetrically cast.
- 3. The shaft and ball shall be integrally cast.
- 4. Seats and seals shall be Teflon and shall be recessed in a machined groove.
- 5. Shaft packing
 - a. Braided band.
 - b. Tightened by means of a gland bearing strip.
 - c. Replacement of the packing shall be accomplished without removing the actuator.

C. Valves shall be by Apollo or equal.

2.11 PVC VALVES

A. General

- 1. Polyvinyl Chloride (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.

B. Ball valves and ball check valves

- 1. True union PVC valves.
- 2. Design to allow for entire valve body removal by turning back the union nut at both ends of the valve.
- 3. Teflon seats and packing.
- 4. Pressure rating of 150 psi at 75 degrees F water.

C. Diaphragm Valves

- 1. Constructed of PVC, except diaphragm, including bonnet and hand wheel.

2. Diaphragm shall be replaceable and fully supported in any position.
 3. Non-rising stem with a diaphragm position indicator.
 4. Diaphragm constructed of Teflon and be replaceable without removing valve from the line.
 5. Valve shall be socket ends.
 6. Valves shall be by Nibco or equal.
- D. The valves shall be pneumatically or manually operated as shown on the drawings. Valve operators shall be supplied as specified under the valve operation Section 2.10.

2.12 PINCH VALVES

A. General

1. Open body, full port design for service up to 75 psig.
2. Designed for a minimum of 50,000 cycles of operation.
3. Incorporate a positive opening device to prevent collapsing under vacuum service.
4. Manufacturer to furnish certified test data of a bubble tight leakage test performance on each valve supplied.

B. Construction

1. Full cast metal body, mechanical pinch type with flange joint ends on both the body and the sleeve trim.
2. 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.
3. Flanges drilled to mate with ANSI B16.1, Class 125/ANSI B16.5, Class 150 flanges.
4. 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.
5. Sleeve trim
 - a. One piece construction with integral flanges drilled to be retained by the flange bolts.
 - b. Reinforced with calendared nylon or calendared polyester fabric to match service conditions.
 - c. Connected to the pinch bar by tabs imbedded in the sleeve trim reinforcing ply.
 - d. All internal valve metal parts are to be completely isolated from the process fluid by the sleeve trim.
6. Full port and reduced port sleeves
 - a. Port areas shall be 100% of the full pipe area at the valve ends.
7. Cone and variable orifice sleeves
 - a. Inlet port area shall be 100% of the full pipe area, reducing to a smaller port at the outlet.
8. 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.
9. Valves for buried service
 - a. Torque tube fitted to the body of the valve via a mounting plate.
 - b. 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.
 - c. Valve shall be operated by turning a non-rising stem, contained within the torque tube, and connected to the pinch mechanism.
 - d. Bevel gear operators shall be provided on all valves over 8" size, and on smaller sizes as specified on the purchase order.

- e. Torque tube shall be epoxy coated for additional corrosion protection.
10. Valves shall be manufactured in the USA.

C. Operation

- 1. 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.
 - 2. Turning the handle counter-clockwise separates the two pinch bars to open the valve.
- D. Pinch valves shall be Series 75-B as manufactured by the Red Valve Co., Inc. of Carnegie, PA, or approved equal.
- E. All valves mounted 6' or more above finished floor shall be provided with chain operators.

2.13 VALVE OPERATORS

- A. Valve operators shall be designed in accordance with the requirements of AWWA Specifications, C504-80 and shall furnish sufficient torque to open and close at 125 percent of the rated working pressure for the valve.
- B. Valves 6 inches and larger shall be gear operated with hand wheels and valves smaller than 6-inches shall be wrench operated, except as hereinafter specified or indicated on the Drawings.
- C. Where there is a lack of space for the valve wrench to operate gear-operators, hand wheels shall be provided in lieu of the wrench.
- D. Chain operators, consisting of sprocket wheels, chain guides and operating chains shall be provided for all valves with operator centerlines located more than 6 feet - 6 inches above the operating level. Operating chain shall be galvanized and shall extend within 3 feet of the operating level. Operators shall develop their maximum capacity with not greater than a 40-lb. pull on the wheel.
- E. Gear operators shall be totally enclosed, worm-gear type, permanently lubricated, and shall be watertight and dust tight.
- F. Gear operators shall be provided with adjustable stops for the open and closed position to prevent over travel, and shall have a valve disk position indicator.
- G. A suitable lever or wrench shall be provided for each six wrench-operated valves and at least one wrench for each operating station. Wrenches or wheels and chains shall be of suitable size and sufficient length for easy operation of the valves at their rated working pressure.
- H. The valve assembly including valve and operator shall be tested to requirements specified herein at the valve manufacturer's factory.

2.14 CHAIN OPERATORS

- A. Valve hand wheel centerlines located more than 6 feet above the floor or operating platforms shall be considered as being inaccessible and shall be provided with chain operators.
- B. Chain wheels and chains shall be provided by the valve manufacturer to operate the particular valve.

- C. Where indicated on the drawings or inaccessible due to size or location, valves shall be provided with chain operators and, where required, angle drives with chains extending to within 3 feet of the floor or operating platform.
- D. Chains shall be galvanized.
- E. Sprocket wheels shall be provided with chain guides.

2.15 MOTOR OPERATORS

A. General

- 1. Provide as shown on the Drawings.
- 2. It shall be the motor operator manufacturer's responsibility to mount and test the valve and actuator assembly to insure proper 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.
 - 1) One switch shall be open and the second switch closed when the valve is fully open.
 - 2) When used with three-way valves, switches shall be used to indicate which outlet is open and which is closed.
 - d. NEMA 4 enclosure.
 - e. Operate on a 120 volt, single phase, 60 Hertz, power supply.
 - f. Capable of holding any valve position.

B. Operation

- 1. Provide 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.
- 2. Hand wheel 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.
- 3. Hand wheel shall be provided with an integral cutoff switch during manual operation.
- 4. 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

- 5. It is the responsibility of the equipment supplier to verify minimum torques and fastest operating speeds for the motor operators supplied.

C. Manufactured by Limitorque Corporation, Jamesbury Corporation, Rotork, Inc., or equal.

D. Construction

1. Provide with shaft seals and shall be totally enclosed, requiring no additional lubrication.
2. Bearings shall be ball or roller type suitable for all loads encountered in the service conditions.
3. Incorporate machine cut and hardened gears.
4. Bolting pattern to allow parallel or perpendicular mounting.

2.16 FLOOR STANDS FOR VALVES

A. General

1. Provided where shown on the Drawings,
2. Straight type design with a 15-inch long hand crank operator, and an operating reduction ratio of two to one.
3. Rising stem type with 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.
4. 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.

B. Construction

1. 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.
2. The pinion shaft shall be mounted with roller and/or needle bearings.
3. Lubrication fittings shall be provided for all bearings.
4. All gearing, bearings, shafts, and the lift nut shall be housed in a weatherproof cast iron housing.
5. Nuts and bolts shall be rust proofed steel.
6. 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.
7. Floor stands shall be provided with stainless anchor bolts for installation.

2.17 TELESCOPING VALVE ASSEMBLIES

A. General

1. Sized to fit riser pipe and penetrate the riser pipe a minimum of 9" in the up position.
2. Unit shall be guaranteed against defects in material and workmanship for a period of three (3) years.

B. Construction

1. The unit shall have a floor stand of 4" square stainless steel tube with 1/8" wall and mounted to 1/2" thick stainless steel base plate.
2. The hand wheel shall be 16" diameter cast aluminum and work in conjunction with a 1 inch square stainless steel rack, 2 inch stainless steel spur gear and oil-impregnated sintered bronze bushings, requiring a maximum of 2 turns for one foot of travel.
3. The sliptube shall be a minimum of 16 ga. stainless steel and incorporate a 150 lbs. stainless steel companion flange and 1/4" thick Neoprene wipe gasket.

C. Provide Series V4R manufactured by Halliday Products, Inc. of Orlando, Florida

2.18 VALVE EXTENSION STEMS

A. General

1. Furnish as required and as shown on the Drawings.
2. Shaft lengths shall suit the particular installation.
3. All exterior valves shall be provided with valve extension stems and valve boxes.
4. Stems shall have a two-inch operating nut and a two-inch coupling for connection of the valves.
5. All operating nuts shall be located 18 inches below finished grade.

2.19 T-HANDLE OPERATING WRENCH

- A. Provide in the number and lengths to operate buried valves by workers of average height working in normal position.

2.20 SOLENOID VALVES

A. General

1. Direct acting packless two-way solenoid valve for water service.
2. Normally closed, unless otherwise shown.
3. Provide for operation with 120 volt, 60 Hertz power and have continuous duty Class A insulation.
4. Valve body to be forged brass with safe body working pressure of at least 250 psi.
5. NPT connections unless indicated otherwise.
6. Buna-N seat.
7. Wetted parts to be stainless steel.

B. Valves shall operate satisfactorily when mounted in any position.

C. Valves shall be by ASCO or equal.

D. Provide general purpose enclosure. Enclosures to meet NEMA Type 4X requirements with coils epoxy encapsulated and suitable for high ambient temperatures (140 degrees F).

2.21 AIR RELEASE VALVES

A. General

1. Allow for the admission or release of large quantities of air during the fill up or drainage of pipelines and shall be specially designed for use with raw sewage.
2. 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.

B. Construction

1. Valves shall consist of a compact tubular all stainless steel fabricated body.
2. HDPE hollow direct acting float.
3. HDPE solid large orifice float.
4. Stainless steel nozzle and woven dirt inhibitor screen.

5. Nitrile rubber seals and natural rubber seat.
6. 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.
7. 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.
8. 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.
9. 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.
10. 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.

C. Connections

1. Flanged ends conforming ANSI B16.1 Class 125.
2. Flanged ends shall be supplied with type 316 stainless steel screwed studs inserted for alignment to the specified standard.
3. Provide type 316 stainless steel nuts and washers.

D. Air and vacuum valves shall be Series RGX by Vent-O-Mat© and sized as indicated on the Drawings.

2.22 PRESSURE REDUCING VALVES (LARGER THAN TWO INCH)

A. General

1. Flanged globe body, bronze mounted, external pilot operated with a free floating piston and shall operate without springs, diaphragms or levers.
2. Single seat with the seat bore equal to the size of the valve.
3. 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.
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 gray 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.

B. Construction

1. Packed with leather and shall be furnished with an indicator rod to show the piston position.
2. Gauge petcocks shall be furnished on the valve body.
3. The pilot valve
 - a. Easily accessible and shall be removable from the main valve under pressure.
 - b. Adjustable without special tools or the removal of springs or weights.
4. The main valve shall be designed to facilitate repairs internally without removing the valve from the line.

5. The valve shall be designed to maintain a preadjusted downstream pressure for varying rates of flow by piston positioning without water hammer.

2.23 PRESSURE REDUCING VALVES (TWO INCHES AND SMALLER)

A. General

1. Single seated balanced design type globe body with threaded inlet and outlet ports.
2. Valves shall be diaphragm operated, spring loaded, and permitting convenient adjustment.

B. Construction

1. The body shall be of bronze construction with stainless steel stem.
2. Furnished with a replaceable rubber seat.

C. Valves shall be G-A Industries Figure 43-D, Watts No. 223, or equal.

2.24 PRESSURE RELIEF VALVE

A. Construction

1. Cast iron frame and cover with a bronze body ring and rubber flap ring.
2. Hinge pin shall be bronze and secured with cotter pins.
3. Valve shall have two pivot points and shall have a flanged end.

B. No leakage shall occur on a valve with at least 18 inches of water cover above the installed valve.

2.25 VACUUM BREAKERS

A. Construction

1. Breakers shall be of Type 1, Grade 1 construction
2. Stainless steel fasteners.
3. Provide with one inch NPT connection.

B. Breakers shall be series "VB" as manufactured by Past-o-matic Valves, Inc., Totowa, NJ, or equal.

2.26 SAMPLING VALVES

A. General

1. Sampling valves and fittings shall be provided on the discharge lines of pumps as shown on the Drawings.

B. Construction

1. Valves shall be one inch stainless steel ball valves manufactured by Apollo or equal
2. Discharge side of each valve shall be provided with a 90 degree stainless steel elbow facing downward.

2.27 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-FLO chemical injection assemblies by SAF-T-FLO Chemical Injection 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.

2.28 SUPPORTS FOR TERMINAL CLEAN-OUT PIPING

- A. Materials and methods to be approved by the Engineer prior to inclusion into the Work.

2.29 HOSE BIBS

A. General

- 1. ¾ inch bronze gate valve with a ¾ inch NPT discharge connection.
- 2. A cap and chain shall be supplied for the outlet.
- 3. Provide Model 372 as made by Jenkins or similar models from Lunkenheimer or Crane or equal.

2.30 QUICK DISCONNECT COUPLINGS

A. General

- 1. Couplings and adapters shall be furnished in the quantities, types and sizes as shown on the Drawings or specified herein.
- 2. The couplings and adapters shall be designed for a working pressure of 200 psig.
- 3. Couplings and adapters shall be of **stainless steel** and shall utilize a cam-type mechanism for connecting the coupler and adapter pieces to provide a leak proof connection.
- 4. No springs, ball bearings or snaps shall be used to make the connection.
- 5. The couplings shall be fitted with Buna-N gaskets recessed into the coupling to prevent the gasket from falling out.
- 6. The disengagement handle pins shall be of stainless steel and stainless steel rings shall be furnished on the handles.

2.31 POLYVINYL CHLORIDE TUBING (FLEXIBLE PVC)

A. Construction

- 1. Nylon braiding incorporated within the walls of the tubing.
- 2. The nylon braiding shall be completely protected by a smooth outside covering of PVC, thus shielding the mesh from conditions detrimental to exterior mesh tubing.
- 3. The tubing shall have a working temperature of minus five degrees F to 175 degrees F.

2.32 VALVE TAGS

A. General

1. 1 ½ inch, square, brass.
2. Stamped ½ inch characters to be black filled.
3. Numbered to owners identification system, if no system is required then number sequentially.
4. Provide each tag with No. 16 brass jack chain in suitable length to attach tag to valve.

PART 3 EXECUTION

3.01 GENERAL

- A. Valves shall be installed as nearly as possible in the positions indicated on the drawings consistent with conveniences of operating the hand wheel or wrench. All valves shall be carefully erected and supported in their respective position free from all distortion and strain in appurtenances during handling and installation. All material shall be carefully inspected for defects in workmanship and material, all debris and foreign material cleaned out of valve openings and seats, all operating mechanisms operated to check their proper functioning, and all nuts and bolts checked for tightness. Valves and other equipment which do not operate easily or are otherwise defective shall be repaired or replaced at the Contractor's expense.
- B. Valves shall not be installed with stems below the horizontal.
- C. Valves shall be set plumb and supported adequately in conformance with the instructions of the manufacturer. Valves mounted on the face of concrete shall be shimmed vertically and grouted in place. Valves in the control piping shall be installed so as to be easily accessible.
- D. Where chain wheels are provided for remote operation of valves two S-shaped hooks shall be provided for each valve to enable the chains to be hooked so as not to interfere with personnel traffic.
- E. Valves shall be provided with extension stems where required for convenience of operation. Extension stems shall be provided for valves installed underground so that operating nuts are located 18 inches below finished grade and elsewhere so that the operating wrench does not exceed 8 feet in length.
- F. A permanent type gasket of uniform thickness shall be provided between flanges of valves and sluice gates and their wall thimble.
- G. Wall thimbles shall be accurately set in the concrete walls so that the gates can be mounted in their respective positions without distortion or strain.

3.02 PLUG VALVES

- A. Plug valves in horizontal sewage and sludge piping shall be installed with the shaft horizontal such that when in the open position, the plug is located in the upper part of the valve body. Valves shall be oriented so that in the closed position, the plug is at the upstream end of the valve.

3.03 VALVE TAGS

- A. Tag valve in visible location, free from interference with operating device, other equipment and personnel.
- B. Develop and provide to Owner, valve chart indicating all valves with corresponding identification number.

3.04 SUPPORTS FOR TERMINAL CLEAN-OUT PIPING

- A. Support to maintain required pitch, prevent vibration, and provide for expansion and contraction.

3.05 PAINTING

- A. Shop and Field Painting shall be as specified under SECTION 09900.

END OF SECTION

SECTION 15130

GAUGES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Requirements to furnish and install gauges at locations indicated on the Drawings and as specified.

PART 2 PRODUCTS

2.01 GENERAL

- A. Gauges include pressure, vacuum and compound gauges of the dial indicating Bourdon tube-type.
- B. Gauges shall be Helicoid Gauges as manufactured by the American Chain and Cable Co., Ashcroft Duragauges by Manning, Maxwell and Moore, Inc., or approved equal.
- C. Pressure gauges shall be designed to indicate pressures above atmospheric pressure only.
- D. Vacuum gauges shall be designed to indicate pressures below atmospheric pressure only.
- E. Compound gauges shall be designed to indicate pressures above and below atmospheric pressure.

2.02 LOCATION

- A. Gauges shall be provided where shown on the Drawings, specified in the Specifications or required for a complete installation. Indicating pressure gauges shall be provided downstream of each pressure regulating valve where shown, specified or required; in the seal water piping of each pump; and on both the suction and discharge piping of each pump except where otherwise specified.

2.03 ACCURACY

- A. Grades of accuracy shall conform to the requirements of American Standard A.S.A. B40.1. The Contractor shall submit manufacturer's certifications indicating that the gauges provided have met the accuracy requirements specified.
- B. Pressure, vacuum and compound gauges shall be Grade AA gauges with an error not exceeding $\frac{1}{2}$ of 1 percent of full-scale range.
- C. Gauges with a flexible seal between the Bourdon tube and the medium to be measured shall have an overall accuracy of Grade A with an error not exceeding one percent of scale range for the middle half and 1-1/2 percent for the remainder of the scale.

2.04 GAUGE CONSTRUCTION

- A. Gauges shall be weatherproof, designed and constructed to meet all requirements for satisfactory operation.
- B. Pressure, vacuum and compound gauges shall be constructed of sound, durable material, free from all defects and imperfections that in any way may affect the accuracy and serviceability of the gauges.
- C. Gauge cases shall be of aluminum, phenolic or polypropylene. Dial shall be 4 1/2 inches nominal diameter with black lettering and scales on a white background, and shall bear a legend showing service and units of graduation. Gauge dial shall be clear and blemish free and sealed to prevent entrance of moist air. Bourdon tube shall be phosphor bronze with forged brass socket. Set point shall be of stainless steel. Socket stem shall extend at least 1-1/4 inches below the gauge case and shall have a large wrench flat.
- D. Pressure gauges shall be graduated in psi unless otherwise specified. Vacuum gauges shall be graduated in inches of mercury; compound gauges shall be graduated in inches of mercury, psi or feet of water as specified.
- E. Maximum scale reading for pressure and compound gauges shall be approximately twice the maximum operating pressure of the fluid to be measured. Vacuum and compound gauges shall have minimum scale readings at 30 inches of mercury unless otherwise shown or specified.
- F. Unless otherwise shown or specified, all pressure, vacuum and compound gauges shall have bottom 1/2-inch NPT male connections.

2.05 DIAPHRAGM PROTECTED GAUGES

- A. The Contractor shall provide diaphragm seals on sludge gauges to prevent the fluid to be measured from clogging or corroding the Bourdon tube of pressure, vacuum and compound gauges.
- B. Diaphragm seals shall be suitable for the gauge furnished; gauges to be used with diaphragm seals shall be Grade AA gauges conforming to the requirements specified herein. Chemical gauges shall have the diaphragm seal as an integral part. Overall accuracy for diaphragm protected units shall be Grade A.
- C. Diaphragms shall have an overall diameter of not less than 2-1/2 inches and shall be made of a material that is corrosion resistant and compatible with the process fluid. Diaphragm protected gauges shall be factory filled with Glycerin oil or approved equal and calibrated by the gauge manufacturer. Unless specified otherwise, diaphragm protected gauges shall be provided with sintered metal snubbers or pulsation dampers.
- D. Diaphragm housing assembly shall be of durable stainless or cadmium plated with a 3/4 inch NPT process connection. The lower housing shall have a 1/4 inch NPT flushing connection and 1/4 inch NPT plug, to allow venting or the introduction of cleaning fluid on the process side of the diaphragm seal. The bottom housing shall be made of a material that is corrosion resistant and compatible with the process fluid. A clean out ring shall be provided to hold the diaphragm captive in the upper housing so that the assembly may be removed for

recalibration or cleaning of the process side without loss of instrument fluid. Diaphragm protected gauges and seals shall be ACCO Helicoid Diaphragm Seal Type 100 HACF, Ashcroft Diaphragm Seal Type 101, or equal.

2.06 GAUGE PROTECTION AND ACCESSORIES

- A. Unless otherwise shown or specified, pressure gauges shall have under pressure protection and vacuum gauges shall have overpressure protection. For helical roller type pressure gauges, the gauge shall have a left hand movement for under pressure protection; for all other gauges, under pressure protection stops shall be provided. For vacuum gauges with helical roller movement, gauges shall have right hand movement for overpressure protection; all other gauges shall have suitable overpressure protection stops.
- B. Unless otherwise shown or specified, all pressure, vacuum and compound gauges shall be provided with stainless steel sintered metal snubbers of porosity suitable for this service. Snubbers shall be ACCO Helicoid No. S-2 or S-4, Ashcroft Chemquip No. 1112S or equal.
- C. Diaphragm protected gauges for normal service shall be provided with rough plumbing 3/4 inch stop valves for shut-off cocks, and 3/4 inch red brass pipe. Valves shall have a bronze body, stainless steel ball, and teflon seats, valves shall have a spring-closing handle.
- D. Gauges other than diaphragm protected gauges shall be installed complete with incidental shut-off cock and tees with test cock with a female outlet. All pipe and fittings shall be brass. The gauge shall be mounted directly in the outlet of the tee-bearing test cock.

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 15140

PIPE HANGERS AND SUPPORTS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes

1. Furnish all labor, materials, equipment and incidentals required to install, and make completely ready for operation, pipe hangers, supports, concrete inserts, and anchor bolts including, metallic hanging and supporting devices as specified herein and as shown on the Drawings.

B. Related work

1. Section 03300 – Cast-In-Place Concrete
2. Section 09900 – Painting

1.02 REFERENCES

A. American Society of Mechanical Engineers (ASME)

1. ASME B31.1, Power Piping

B. Manufacturers Standardization Society Standard Practice (MSS-SP)

1. MSS-SP-58, Pipe Hangers and Supports, Materials, Design and Manufacture.
2. MSS-SP-69, Pipe Hangers and Supports, Selection and Application.

1.03 REQUIREMENTS

A. Design Requirements

1. The equipment specified herein is intended to support the various types of pipe and piping systems required for the Work.
2. The details shown on the Drawings are intended to indicate the generally desired methods of support under normal conditions.
3. All supports shall be designed to adequately secure the pipe against excessive dislocation due to thermal expansion and contraction, internal flow forces, and all probable external forces such as equipment, pipe, and personnel contact through 360 degrees in all three dimensions.
4. It shall be the responsibility of the Contractor to provide a Professional Mechanical Engineer licensed in the **Commonwealth of Massachusetts**, with a minimum of 5 years of demonstrated experience in the design of supports and connections, to design the supports and connections for all equipment for all weights and applied pressures as indicated on the Drawings.
5. In the design of hangers, supports and anchors, pipe pressures shall be taken as the maximum rated pressure specified for pipe lines carrying gases and air and twice the maximum rated pressure specified for pipe lines carrying liquids.
6. Payment for such design services shall be included in the Prices bid for furnishing and installing pipe lines.

7. Hangers and supports shall be of approved standard design where possible and shall be adequate to maintain the supported load in proper position under all operating conditions.
8. All supporting equipment, with the exception of springs, shall be designed with a minimum working factor of safety of five based on the ultimate tensile strength of the material.
9. Where additional structural members are required, they shall be designed for the specific loads they are to support in accordance with the requirements of **Commonwealth of Massachusetts Building Code**.

B. Performance Requirements

1. All hangers, supports and appurtenances shall conform to the latest requirements of the following listed references except as supplemented or modified by the requirements of this Specification.
 - a. ANSI B 31.1.
 - b. MSS-SP-58.
 - c. MSS-SP-69.

1.04 SUBMITTALS

A. In accordance with SECTION 01300.

1. Representative catalog cut for each different type of pipe hanger or support indicating the materials of construction, important dimensions and range of pipe sizes for which that hanger is suitable. Where standard hangers are not suitable, submit detailed drawings showing materials and details of construction for each type.
 2. Complete piping drawings indicating type of hanger, location, and magnitude of load transmitted to the structure. Submittals shall use detail numbers as shown on the Drawings to indicate type of support proposed wherever possible.
- B. Design computations shall not be submitted for review. Any design computations submitted shall be returned without comment. A design certificate shall be submitted prior to installation of any piping.

1.05 DELIVERY, STORAGE AND HANDLING

- A. All supports and hangers shall be crated, delivered and uncrated so as to protect against any damage.
- B. All parts shall be properly protected so that no damage or deterioration shall occur during a prolonged delay from the time of shipment until installation is completed.
- C. Finished iron or steel surfaces not galvanized or painted shall be properly protected to prevent rust and corrosion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Unless otherwise specified herein, pipe hangers and supports shall be as manufactured by the following:

1. Grinnell Corp., Providence, Rhode Island.
 2. Carpenter & Patterson, Inc., Woburn, Massachusetts.
 3. F&S Central, Brooklyn, New York.
 4. Elcen Metal Products Co., Franklin Park, Illinois.
 5. Unistrut Northeast, Woburn, Massachusetts
- B. Any reference to a specific figure number of a specific manufacturer is for the purpose of establishing a type and quality of product and shall not be considered as proprietary. Any item comparable in type, style, quality, design and performance shall be considered as equal.
- C. The Drawings and Specifications indicate general and specific methods and details of supporting the various piping systems. Any changes to the support details shown shall be submitted to the Engineer for review.
- D. All uninsulated non-metallic piping such as PVC, fiberglass, etc. shall be protected from local stress concentrations, at each support point by galvanized steel protection shields or other method as approved by the Engineer where pipes are bottom supported 180 degree arc shields shall be furnished. Where 360 degree arc support is required, such as U Bolts, protection shields shall have a 50 mils minimum thickness, not be less than 12 inches in length and be securely fastened to pipe with stainless steel or galvanized metal straps not less than 1/2 inch wide.
- E. All insulated pipe shall be furnished with a rigid foam insulating saddle at each pipe support location as specified under insulation. Provide galvanized protection shields as specified in Paragraph 2.01D above at each location.
- F. Where pipe hangers and supports come in contact with copper piping provide protection from galvanic corrosion by the following:
1. Wrap pipe with 60 mils thick neoprene sheet material and galvanized protection shield.
 2. Provide isolators similar to Elcen figure number 228.
 3. Provide copper plated or PVC coated hangers and supports.
- G. Pipe supports shall be provided as follows:
1. Cast iron soil pipe: maximum support spacing of 5.0 feet with a minimum of one support per pipe section at the joints.
 2. Steel pipe: maximum support spacing of 10 feet with a minimum of one support per pipe section at the joints.
 3. Fiberglass pipe: as recommended by the manufacturer except that support spacing shall not exceed 5 feet.
 4. PVC pipe: as recommended by the manufacturer except that support spacing shall not exceed 3 feet. For pipe equal to or less than I inch in diameter and 5 feet for all other pipe sizes.
 5. Support spacing for steel pipe 2 inches and smaller and copper tubing shall not exceed 5 feet.
 6. Ductile iron pipe: maximum support spacing of 10 feet with a minimum of one support per pipe section at the joints.
 7. All vertical pipe shall be supported at each floor or at intervals of not more than 12 feet by approved pipe collars, clamps, brackets, or wall rests, and at all points necessary to insure rigid construction.
 8. Pipe supports shall not induce point loadings but shall distribute pipe loads evenly along the pipe circumference.

9. Effects of thermal expansion and contraction of the pipe shall be accounted for in the pipe support selection and installation.

2.02 SINGLE PIPE HANGERS

- A. Single pipes shall be supported by hangers suspended by galvanized steel rods from structural steel members, concrete ceilings and beams, bottom of trapeze hangers and wall mounted steel angle brackets.
- B. Hanger rods shall be hot rolled steel, machine threaded and galvanized after fabrication. The strength of the rod shall be based on its root diameter.
- C. Except as otherwise specified herein, pipe hangers shall be adjustable clevis type similar to Grinnell Figure Numbers 65, 260, and 590 as required. Hangers shall be carbon steel with a galvanized finish.
- D. Hanger rods shall be attached to concrete structures using concrete inserts similar to F&S Figures 180, 571 or 150. Inserts shall be malleable iron, or steel with galvanized finish. Beam dampers, C clamps or welded beam attachments shall be used for attaching hanger rods to structural steel members. Where necessary and approved by the Engineer double expansion shields shall be used for attaching to concrete structures.
- E. Where pipes are near walls, beams, columns, etc. and located an excessive distance from ceilings or underside of beams, welded steel wall brackets similar to Carpenter and Patterson Figure numbers 69-68, 84 or 139 shall be used for hanging pipe. Brackets shall be galvanized. Where single pipes rest on top of bracket pipe supports, attachments shall meet requirements as specified under multiple pipe hangers.

2.03 MULTIPLE PIPE HANGERS

- A. Suspended multiple pipes, running parallel in the same horizontal plane, which are adjacent to each other shall be suspended by trapeze type hangers or wall brackets. Trapeze hangers shall consist of galvanized structural steel channel supported from galvanized threaded rod or attached to concrete walls, columns or structural steel support members as required to meet the intent of this specification. Channel shall be similar to F&S Figure 710, rods, concrete inserts, "C" Clamps, beam clamps, welded beam attachments, and expansion shields shall be as specified in 2.02 Single Pipe Hangers.
- B. Except as otherwise specified herein pipe anchors used for attaching pipe to trapeze or multiple pipe wall brackets shall be anchor or pipe chair similar to F&S Figures 158, 419, 160A, 160B as required. Materials of construction shall be galvanized steel. Chair "U" bolts shall be tightened to allow freedom of movement for normal expansion and contraction except when pipe must be anchored to control direction of movement or act as a thrust anchor.

2.04 SINGLE AND MULTIPLE PIPE SUPPORTS

- A. Single pipes located in a horizontal plane close to the floor shall be supported by one of the methods specified herein or as shown on the Drawings.

- B. Pipes 3-inch diameter and larger shall be supported by adjustable stanchions similar to F&S Figure 427, constructed of galvanized steel. Stanchions shall provide at least 4-inch adjustment and be flange mounted to floor,
- C. Pipes less than 3-inches in diameter shall be held in position by supports fabricated from steel "C" channel, welded post base similar to Unistrut Figure P2072A and pipe clamps similar to Unistrut Figures P1109 thru P1126. Where required to assure adequate support, fabricate supports using two vertical members and post bases connected together by horizontal member of sufficient load capacity to support pipe. Wherever possible supports shall be fastened to nearby walls or other structural member to provide horizontal rigidity. More than one pipe may be supported from a common fabricated support. All supports unless specified elsewhere shall be galvanized.
- D. Where required, pipe shall be supported using concrete anchor posts constructed in accordance with SECTION 03300. Pipe shall be securely fastened to concrete anchor posts using suitable metal straps as required and approved by the Engineer.

2.05 WALL SUPPORTED PIPES

- A. Single or multiple pipes located adjacent to walls, columns or other structural members shall whenever deemed necessary shall be supported using welded steel wall brackets similar to Carpenter and Patterson Figure numbers 69-78, 84, or 134; or "C" Channel with steel brackets similar to Unistrut pipe clamps. All members shall be securely fastened to wall, column, etc. using double expansion shields or other method as approved by the Engineer.
- B. Pipe shall be attached to supports using methods hereinbefore specified to meet the intent of this Specification.
- C. All supports shall be galvanized.

2.06 BASE ANCHOR SUPPORT

- A. Where pipes change direction from horizontal to vertical via a bend, a welded or cast base anchor support shall be installed at the bend to carry the load. The bend anchor shall be fastened to the floor with double expansion shields or other method as approved by the Engineer.
- B. Where shown on the Drawings, pipe bends shall be supported using concrete anchor posts. Pipes shall be securely fastened to concrete supports with suitable metal bands as required and approved by the Engineer.

2.07 VERTICAL PIPE SUPPORTS

- A. Where vertical pipes are not supported by a Unistrut system as specified in Paragraph 2.08, they shall be supported in one of the following methods.
 - 1. For pipes 1/4-inch to 2-inch in diameter, an extension hanger ring shall be provided with an extension rod and hanger flange. The rod diameter shall be as recommended by the manufacturer for the type of pipe be supported. The hanger ring shall be galvanized steel or PVC clad depending, on the supported pipe. The hanger ring shall be equal to

- Carpenter & Peterson Figure number 81 or 81CT. The anchor flange shall be galvanized malleable iron similar to Carpenter & Patterson Figure number 85.
2. For pipes equal to or greater than 1/2-inch in diameter extended pipe clamps similar to Carpenter and Patterson Figure number 267 may be used. The hanger shall be attached to concrete structures using double expansion shields, or to steel support numbers using welding lugs similar to Carpenter & Patterson Figure number 220.
 3. Pipe riser clamps shall be used to support all vertical pipes extending, through floor slabs. Riser clamps shall be galvanized steel similar to Carpenter & Patterson Figure number 126. Copper clad or PVC coated clamps shall be used on copper pipes. Insulation shall be removed from insulated pipes prior to installing riser damp.
 4. Unless otherwise specified, shown, or specifically approved by the Engineer, vertical runs exceeding 11 feet, pipes shall be supported by approved pipe collars, clamps, brackets or wall rests at all points required to insure a rigid installation.

2.08 SPECIAL SUPPORTS

- A. Pipe supports shall be provided for closely spaced vertical piping systems as shown on the Drawings or as otherwise required to provide a rigid installation. The support system shall consist of a framework suitably anchored to floors, ceilings and walls and be as manufactured by the Unistrut Corporation, Globe-Strut as manufactured by the Metal Products Division of U.S. Gypsum, or equal.
- B. Vertical and horizontal supporting members shall be U shaped channels similar to Unistrut Series P1000. Vertical piping shall be secured to the horizontal members by pipe clamps or pipe straps equal to Unistrut series P1100M and series P2558. All components shall be of mild steel.
- C. The assemblies shall be furnished complete with all nuts, bolts, and fittings required for a complete assembly including end caps for all members.
- D. The design of each individual framing system shall be the responsibility of the Contractor. Shop drawings, as specified above shall be submitted and shall show all details of the installation, including dimensions and types of supports. In all instances the completed frame shall be adequately braced to provide a complete rigid structure when all the piping has been attached.
- E. Any required pipe supports for which the supports specified in this Section are not applicable shall be fabricated or constructed from standard structural steel shapes in accordance with AISC Specifications, have anchor hardware similar to items previously specified herein, shall meet the minimum requirements listed below and be subject to the approval of the Engineer.
 1. Pipe support systems shall meet all requirements of this Section and all related Sections of the Specification.
 2. Complete design details of the entire pipe support systems shall be provided, for review by the Engineer.
 3. The pipe support system shall not impose loads on the supporting structures in excess of the loads for which the supporting structure is designed.

2.09 SURFACE PREPARATION AND SHOP PAINTING

- A. All surfaces shall be prepared and shop painted as part of the work of this Section. Surface preparation and shop painting shall be as specified in SECTION 09900.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Pipe and appurtenances connected to the equipment shall be supported in a manner to prevent any strain from being imposed on the equipment or piping system.
- B. Pipe and tubing shall be supported as required to prevent damaging stresses in the pipe or tubing material, valves and fittings, and to support and secure the pipe in the intended position and alignment. Supports shall be sufficiently close together such that the sag of the pipe is within limits that will permit drainage and avoid excessive bending stresses from concentrated loads between supports.
- C. Pipes, horizontal and vertical, requiring rigid support shall be supported from the building structure by approved methods. Supports shall be provided at changes in direction and elsewhere as shown in the Drawings or specific herein. No piping shall be supported from metal stairs, ladders and walkways unless specifically directed or authorized by the engineer.
- D. Where flexible couplings are required at equipment, tanks, etc. the end Opposite to the piece of equipment, tank, etc. shall be rigidly supported.
- E. Pipe supports shall be installed to minimize, lateral forces through valves, both sides of split type couplings and sleeve type couplings, and to minimize all pipe forces on pump housings. Pump housings shall not be utilized to support connection pipes.

END OF SECTION

CERTIFICATE OF DESIGN FOR PIPE HANGERS AND SUPPORTS

(Owner)

Contract Reference: _____

_____, dated _____.

In accordance with the provisions of the above referenced Contract, as the designated Contractor,

(Contractor's Name and Address)

hereby certifies that _____

(Contractor's Name and Address)

- (1) Is properly licensed and currently registered as a Professional Engineer in the State (or Commonwealth) of _____;
- (2) Is fully qualified to design and supervise the _____

(Item of work and location)

In accordance with the provision specified under the appropriate Section and/or Subsections of the Contract Documents:

- (3) Has successfully designed and supervised _____

(Item of work)

before and demonstrates a minimum of ten (10) documented years of proven experience in such field;

- (4) Has personally examined the type(s) and locations(s) of the Work required under this Contract, and the overall conditions associated therewith, to the extent necessary to fully satisfy his or her professional responsibilities for designing and supervising the above referenced work;

- (5) Has prepared the attached design in full compliance with the applications and requirements of the Contract Documents, sound engineering practice, modern accepted principles of construction, and all applicable federal, state and local laws, regulations, rules and codes having jurisdiction over the Work;
- (6) Will provide sufficient supervision and technical guidance to the Contractor throughout the Work to ensure compliance with the design and all quality assurances necessary to successfully complete the Work;
- (7) Hereby indemnifies and holds harmless the _____
 _____ and BETA Group, Inc.,
 (name of owner)
 and their agents, employees and representatives, from and against any and all claims, whether directly or indirectly, arising out of, relating to or in connection with the Work; and
- (8) This "Certificate of Design" together with all applicable designs, drawings, details, specifications on other related documents necessary to complete the Work as specified, have been signed and sealed pursuant to applicable state law.

In recognition and observance of the above referenced statements, the undersigned parties hereby acknowledge and accept the responsibilities and obligations associated therewith.

CONTRACTOR:CONTRACTOR'S ENGINEER

(Contractor's Name)

(Engineer's Name)

By: _____

By: _____

(Name and Title)

(Name and Title)

Date: _____
(SEAL)

Date: _____
(P.E. STAMP)

(Note: Contractor to fully reference all attachments below)

END OF SECTION

SECTION 15400

PLUMBING

PART 1 - GENERAL

1.01 DESCRIPTION

- 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 the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1 – GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.
- C. The Work includes, without limiting the generality thereof:
 - 1. Demolition of gas piping from existing riser supplying meter into building and all gas piping inside the building.
 - 2. Water supply system
 - 3. Domestic cold-water distribution system.
 - 4. Domestic hot water and water heater, including recirculation pump.
 - 5. Plumbing fixtures.
 - 6. Hose Bibbs.
 - 7. Demolition of Plumbing Systems.

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. Domestic water heater
7. Domestic hot water recirculation pump.
8. Plumbing Fixtures
9. Mixing valve
10. Cleanouts
11. Piping insulation

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 16120, WIRE AND CABLES - Power wiring.

1.04 ITEMS INSTALLED BUT NOT FURNISHED

- A. None.

1.05 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. American Gas Association (AGA).
 - c. National Fire Protection Association (NFPA).
 - d. Occupational Safety and Health Act (OSHA).
 - e. Underwriter's Laboratories (UL).
 - f. 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).

1.06 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.

1.07 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.
- D. Deliver all materials as needed to avoid delaying any Work.
- E. Store all materials and equipment on the Project Site in a location approved by the Engineer.

1.08 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.
- 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 Contractor 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. If the required material, installation or Work can be interpreted differently from drawing to drawing, or between Contract Drawings and Specifications, the Contractor shall provide that material, installation, or Work which is of the higher standard.
- G. 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.

1.09 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.

1.10 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.

1.11 MATERIAL LIST

- A. Within 4 weeks of Award of Contract, 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.

1.12 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 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 additional 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.

1.13 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.

1.14 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 and make good damage thus caused at no additional cost to the Owner.

1.15 SUPERVISION

- A. Supply the service of an experienced and competent supervisor who shall be in charge of the plumbing Work at the Project Site.

1.16 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.

1.17 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 Contractor of any responsibilities under the guarantees specified herein.

1.19 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.

1.20 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 the Contractor's expense without any additional cost to the Owner.

1.21 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 Contractor and shall be of sufficient strength and size to allow only a minimum deflection in conformance with the manufacturer's requirements for loading.

1.22 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.

1.23 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.

1.24 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.

PART 2 MATERIALS

2.01 WATER PIPE AND FITTINGS

- A. Above floor piping shall be Type L copper tubing, ASTM B88, hard tempered, with wrought copper fittings and unions, joints made up with 95/5 tin antimony solder and non-corrosive flux.
- B. Under ground and under slab piping 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 AND WASTE PIPE AND FITTINGS

- A. Below grade shall be service weight cast iron soil pipe and fittings, ASTM A74, coated with tar or asphaltum, resilient gasket joints.
- A. 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.
- B. 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 NATURAL GAS PIPING AND GAS RELIEF VENTS

- A. Gas piping 2 inches and smaller shall be Schedule 40 black steel pipe with malleable iron threaded cast fittings ASTM B16.3, Class 150.
- B. Gas piping 2-1/2 inches and larger shall be schedule 40 black steel pipe in accordance with ASTM A.53 with butt welding fittings in accordance with ANSI B16.9.
- C. Gas piping at equipment shall be provided with additional supports.
- D. All Work shall be installed in strict accordance with the Massachusetts State Gas Code.
- E. Welders Qualifications (Natural Gas System): Qualifications of the procedure and of the welding operations and welders shall be as specified in American Welding Society, AWS D10.9-80, "Specification for Qualification of Welding Procedures and Welders for Pipe and Tubing"; ANSI B31.1 and ASME Boiler Code, Section IX. The Contractor shall provide certification in writing that the operator or welder has met the prescribed standard. The Owner reserves the right to radio graphically test a minimum of 5% of the welds.

2.04 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.
- E. Gas piping installed on the roof shall be set on rubber pipe supports as manufactured by "The Rubber Triangle Co." or an approved equal.

2.05 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.

2.06 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 heaters) shall be combination pressure/temperature relief valves, AGA rated and 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 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 PPP, Watts, Wade or approved equal.
- G. Furnish and install flexible connectors on supply piping off pumps. Flexible connectors shall be equal to Metraflex Model SST, double braided with 304 stainless steel threaded ends.
- H. Provide dielectric couplings at all ferrous to non-ferrous joints.
- I. 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.

2.07 VALVES

- A. 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.
- B. 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.
- C. Ball valves for gas service shall be steel body full port pattern with reinforced PTFE seals, PTFE seats, threaded ends and shall be UL listed.
- 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.

2.08 GAS EQUIPMENT CONNECTORS

- A. All gas equipment connectors shall be AGA-approved.
 - 1. Flexible Connectors: ANSI Z21.45 and approved for use in Massachusetts.
 - 2. Quick Disconnect Couplings: ANSI Z21.41.
 - 3. Semi-Rigid Tubing and Fittings: ANSI Z21.69.

2.09 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.

2.10 PLUMBING FIXTURES

- A. Hose Bibb (HB)
 - 1. Chicago Faucets 998-RCF rough chrome plated, inside sill fitting with body drain plug and vacuum breaker, wall mounted metal tee handle, compression rebuildable cartridge, 3/4" NPT female inlet, 3/4" NPT male garden hose outlet.
- B. Emergency Shower/Eyewash (EWU-1)
 - 1. Guardian, Speakman, Encon, or approved equal. Guardian model G1950 combination drench shower and eye wash fountain. Unit shall be complete with 1 1/4 inch Schedule 40 galvanized steel pipe standard with 1 1/4 inch supply and 1 1/4 inch waste, double pole double throw flow switch, alarm horn, flashing light, thermostatic valve, aluminum floor flange, plastic shower head, plastic steel eye wash bowl, valves, eye wash outlet head assembly, and ANSI compliant identification sign.
 - 2. Valves: Shower valve shall be 1 inch IPS chrome plated brass stay-open ball valve complete with actuating arm and pull rod. Eye wash valve shall be 1/2 inch IPS chrome plated brass stay-open ball valve activated by flag handle.

3. Eye wash outlet head assembly shall be two spray heads mounted on chrome plated brass supply arms. Each spray head shall have dust cover, internal flow control and filter.
- C. Water Closet (P-1)
1. Sloan, Toto, American Standard, or approved equal.
 - a. Fixture: Sloan model WETS-8029.8010, ADA compliant, elongated, floor mount, vitreous china, 1.28 gallon per flush pressure assist tank type 20 psig minimum pressure required.
 - b. Seat: Church
- D. Lavatory (P-2)
1. Elkay, Toto, American Standard or approved equal.
 - a. Fixture: Elkay model ELV2219, ADA compliant, 22inch x 19 inch wall hung, stainless steel.
 - b. Faucet: Elkay LK800GN08T4-ISM 1.5 gpm deck mounted double handled utility faucet with gooseneck spout.
 - c. Offset Drain: Elkay off set drain.
 - d. Supports: integral stainless steel support brackets.
 - e. Miscellaneous: Stops, supplies, p-trap and handicap insulators.

2.11 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 (hot water pipe size up to 1½ inch)
2. 1½ inch thickness fiberglass piping insulation (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.

2.12 ELECTRIC WATER HEATER

- A. Electric water heater shall be as manufactured by A.O. Smith, State or approved equal.
- B. DWH-1: Water heater shall be model DRE-120-15, having electrical input of 15 KW, 480 VAC, 3 phase and a recovery rate of 61 gph at a 100°F temperature rise. Heater shall consist of a 119 gallon glass lined steel tank ASME rated for 150 psig, incoloy sheathed heating elements, integral fusing, terminal block, thermostat adjustable for 120 to 180 deg F, two anode rods, ASME temperature and pressure relief valve and drain valve.

2.13 DOMESTIC HOT WATER RECIRCULATION PUMP

- A. The Domestic Hot Water Recirculation Pump shall be a bronze volute cartridge pump suitable for potable water. Pump shall include an integral check valve, replaceable cartridge, non-metallic impeller and 115 VAC/1/60 hz motor. Pump shall be equal to Taco 006B with a capacity of 2 gpm at 6 feet of head.
- B. Furnish, install and wire an aquastat equal to Honeywell L4006A. Aquastat shall clamp to recirculation line and the aquastat contacts shall cycle the recirculation pump to maintain a recirculation setpoint of 100 deg F. (adjustable)

2.14 SUMP PUMPS

- A. Sump pumps shall be equal to Liberty Pump Model 237. Pumps shall consist of polypropylene and powder coated aluminum casing, stainless steel rotor shaft, high

temperature engineered thermoplastic vortex style impeller, oil-filled hermetically sealed motor, permanently lubricated upper and lower bearings, 1/3 hp 115 VAC 1 phase motor, 1-1/2" discharge connection, 10-foot-long electrical power cord, and vertical magnetic float switch. Pumps shall be capable of 20 gpm flow at 15 feet of head and shall be able to handle 3/8" solids. Pumps shall be able to operate in a 10 inch diameter sump.

PART 3 EXECUTION

3.01 CUTTING AND PATCHING

- A. Do all cutting and patching required for the Work. Concrete cutting shall be done with abrasive wheels or saws, and coring with a diamond core bit. The use of jackhammers is prohibited.

3.02 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.

3.03 INSTALLATION OF PIPING

- A. Provide a shutoff valve on each pressure piping connection at each item of equipment, except vent and overflow connections.
- B. Provide a drain connection at each reduced pressure backflow preventer air gap to receive the discharge from the backflow preventer and convey it to the sanitary drain system.
- C. Do not install valves with the stem below horizontal.
- D. Provide a union or flange at each connection at each item of equipment.
- E. Install piping parallel to or perpendicular to the lines of the building.
- F. Pitch all pressurized water piping up 1 inch in 80 feet, or run dead level and provide an air vent every 40 feet.

3.04 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.

3.05 DISINFECTION, CLEANING AND ADJUSTING

A. Disinfection

1. Each potable water system (cold and hot water) shall be cleaned and disinfected by the Contractor. Cleaning and disinfection shall be performed after all pipes, valves, fixtures and other components of the systems are installed, tested and ready for operation.
2. All hot and cold water piping shall be thoroughly flushed with clean potable water, prior to disinfection, to remove dirt and other contaminants. Screens of faucets shall be removed before flushing and re-installed after completion of disinfection.
3. Provide pipe flushing report to Owner within one week of completion of flushing.
4. Disinfection shall be done using sodium hypochlorite in the following manner:
 - a. A service cock shall be provided and located at the water service entrance. The disinfecting agent shall be injected into and through the system from this cock only.
 - b. The disinfecting agent shall be injected by a proportioning pump or device through the service cock slowly and continuously at an even rate. During disinfection, flow of disinfecting agent into main water supply is not permitted.
 - c. All sectional valves shall be opened during disinfection. All outlets shall be fully opened at least twice during injection and the residual checked with orthotolidin solution.
 - d. When the chlorine residual concentration, calculated on the volume of water the piping will contain indicated not less than 50 ppm (parts per million) at all outlets, then all valves shall be closed and secured.
 - e. The residual chlorine shall be retained in the piping systems for a period of not less than 24 hours.
 - f. After the retention, the residual shall be not less than five parts per million. If less, then the process shall be repeated as described above.
 - g. If satisfactory, then all fixtures shall be flushed with clean potable water until residual chlorine by orthotolidin tests shall be not greater than the incoming water supply. (This may be zero.)
5. All Work and certification of performance shall be performed by approved applicators or qualified personnel with chemical and laboratory experience. Certification of performance shall indicate:
 - a. Name and location of the job and date when disinfection was performed.

- b. Material used for disinfection.
 - c. Retention period of disinfectant in piping system.
 - d. ppm chlorine during retention.
 - e. ppm chlorine after flushing.
 - f. Statement that disinfection was performed as specified.
 - g. Signature and address of company or person performing disinfection.
6. Upon completion of final flushing (after retention period) the Contractor shall obtain a minimum of one water sample from each hot and cold water line and submit samples to a State-approved laboratory. Samples shall be taken from faucets located at highest floor and furthest from meter or main water supply. The laboratory report shall show the following:
- a. Name and address of approved laboratory testing the samples.
 - b. Name and location of job and date the samples were obtained.
 - c. The coliform organism count. (An acceptable test shall show the absence of coliform organisms.)
 - c. The heterotrophic plate count (HPC). (An acceptable test shall show less than 500 CFU/ml.)
7. If analysis does not satisfy the above minimum requirements, the disinfection procedure shall be repeated.
8. Before acceptance of the systems, the Contractor shall submit to the Owner for review, three (3) copies of Certification of Performance as specified above.
9. Under no circumstances shall the Contractor permit the use of any portion of domestic water systems until properly disinfected, flushed and certified.

B. Cleaning and Adjusting

1. At the completion of the Work, all parts of the installation shall be thoroughly cleaned. All equipment, pipe, valves and fittings shall be cleaned of grease, metal cuttings and sludge which may have accumulated by operation of the system for testing.
2. Any stoppage or discoloration or other damage to parts of the building, its finish, or furnishings due to the Contractor's failure to properly clean the piping system shall be repaired by the Contractor at no additional cost to the Owner.

3. At the completion of the Work, all water systems shall be adjusted for quiet operation.
4. All automatic control devices shall be adjusted for proper operation.
5. All plumbing fixtures and exposed metal work shall be cleaned and polished. All traps shall be cleaned of all debris.
6. All items of equipment shall be thoroughly inspected. Any items dented, scratched or otherwise damaged in any manner shall be replaced or repaired and painted to match the original finish. All items so repaired and refinished shall be brought to the attention of the Owner for inspection and approval.

3.06 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.

3.07 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 (HVAC)

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. Demolition of existing gas furnaces, stack, piping, hangers, insulation, unit heaters, ductwork and controls.
 - 2. Demolition of existing Generator intake, Generator muffler, and controls.
 - 3. Rooftop Energy Recovery Unit and Controls
 - 4. Supply, return and exhaust ventilation ductwork.
 - 5. Testing, adjusting and balancing.
 - 6. Standalone Temperature Controls
 - 7. Demolition of HVAC Systems.

1.02 SUBMITTALS

- A. Submit the following in accordance with Section 01300:
 - 1. Rooftop Energy Recovery Unit and Controls
 - 2. Electric Unit Heaters
 - 3. Ductwork
 - 4. Ductwork accessories
 - 5. Insulation
 - 6. Standalone Temperature Controls

1.03 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 05500, Metal Fabrications
- B. Section 09900, Painting

1.04 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. Rooftop Energy Recovery Unit and Controls
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.

1.05 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.

1.06 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. Perform all Work with the Contractor's safety program.
- D. Deliver all materials as needed to avoid delays.

1.07 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 system's 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. If the required material, installation, or Work can be interpreted differently from drawing to drawing, or between Contract Drawings and Specifications, the Contractor shall provide that material, installation, or Work which is of the higher standard.

1.08 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.
- B. Check Contract Drawings and Shop Drawings to verify and coordinate spaces in which Work of this section will be installed.
- C. Maintain maximum headroom at all locations. All piping, duct, and associated components to be as tight to underside of structure as possible.

1.09 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 duration of the Contract, maintain complete and separate set of prints of Contract Drawings at the 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. Drawings shall show record condition of details, sections, control changes and corrections to schedules. Schedules shall show actual manufacturer and make and model numbers of final equipment installation.

1.10 MANUFACTURER'S SERVICES

- A. Provide manufacturer's services for testing, training and start-up of the following equipment:
 - 1. Rooftop Energy Recovery Unit and Controls.
- 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.

1.11 ELECTRICAL WORK

- A. 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.
- B. All motors 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.
- C. 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.
- D. 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.
- E. **This section includes the materials and labor for conduit; and the labor to run the control wiring between the ERV and the Remote Interface Panel. The wiring shall be furnished by the ERV manufacturer.**
- F. All electrical apparatus furnished under this section shall be approved by UL and shall be labeled or listed where such is applicable.

1.12 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, including Articles 6 and 13 of the Standard General Conditions.

- B. Guarantee that all elements of each system meet the specified performance requirements as set forth herein or as indicated on the Contract Drawings.
- C. 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.

1.13 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.

1.14 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 and make good damage thus caused at no additional cost to the Owner.

1.15 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.

1.16 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.

1.17 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.

1.18 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 the Contractor's expense without any additional cost to the Owner.

1.19 SUPPLEMENTARY STEEL, CHANNELS AND SUPPORTS

- A. Provide all supplementary steel, 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 Contractor 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.

1.20 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.

1.21 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.

1.22 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.

PART 2 - MATERIALS

2.01 PIPE AND FITTINGS

- A. 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.

2.02 HANGERS AND SUPPORTS

- A. All hangers and supports shall be stainless steel.
- B. 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.
- C. 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.

- D. 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).
- 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.

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. 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 ENERGY RECOVERY UNIT (ERU)

- A. Provide an outdoor mounted, rotary air-to-air energy recovery ventilator as manufactured by Valent, Greenheck, Haakon, Daikin Applied Custom, or equal. Unit shall be manufactured for outdoor construction. The unit shall include a rotary wheel exchanger with a Variable Frequency Drive, supply air and exhaust air plenum style fans, fan motors with Variable Frequency Drives, air filters, gas heating section, DX cooling coil, DX reheat coil, and specified options.

B. Quality Assurance

- 1. Entire Unit: ETL Certified per UL 1995 and shall bear an ETL sticker.
- 2. Energy Wheel: AHRI Certified per Standard 1060.
- 3. DX Coils: AHRI Certified per Standard 410-2001.
- 4. Gas Burner: ETL certified as a component of the unit.
- 5. AMCA 210 Laboratory Methods of Testing Fans for Rating Purposes

- 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 include duct connections and service clearance requirements. 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 including AHRI certified coil performance, 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 Remote Interface and a wiring diagram for the interface to the ERU.
 6. Submittal shall include the manufacturers recommended installation instructions.
- E. Construction
1. Furnish and install a 14-gauge galvanized steel curb for unit support. Curb shall provide perimeter support for the entire ERU and shall have duct adapters for supply and return air ductwork. Inside of curb shall be insulated with 2-inch-thick rigid insulation.
 2. All cabinet walls, access doors, floor and roof shall be fabricated of double wall, impact resistant, panels insulated with fiberglass or foam. Outer wall and roof panels shall be constructed of 18-gauge G90 galvanized steel. Inner wall shall be fabricated from 24-gauge G90 galvanized steel; motor supports shall be fabricated from 14-gauge G90 galvanized steel and other internal structural components shall be fabricated from 20-gauge G90 galvanized steel. Access panels and doors shall be insulated and shall be fabricated from 22-gauge G90 galvanized steel. Doors and panels shall be arranged to provide easy access to all major components.

3. Insulation: Unit walls and roof shall be completely insulated. Insulation shall be at least 2 inch thickness, have a minimum density of 3 pounds/cubic foot and have a minimum R-value of 7.5 per inch. 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.
4. Condensate drain pan shall be stainless steel sloped in two directions for positive drainage. Pan shall be furnished with a connection for condensate drain piping.

G. Rotary Air-To-Air Heat Exchanger

1. Unit energy wheel shall be sized for the full volume of outdoor and exhaust air without an energy wheel bypass damper(s). Energy wheel shall be of total enthalpy rotary air-to-air type and shall be an element of a removeable energy wheel cassette. The cassette shall consist of a galvanized steel framework designed to produce laminar flow through the wheel, and energy wheel as specified and a motor with a VFD drive assembly. The cassette shall incorporate a pre-tensioned drive belt with a five-year warranty. The wheel media shall be a polymer film matrix in a stainless-steel framework and be comprised of individual segments that are removeable for servicing. **Non-segmented energy wheels are not acceptable.** Silica gel desiccant shall be permanently bonded to the polymer film and shall allow cleaning and servicing. **Energy wheel shall have a five-year warranty.** Performance criteria are to be as specified in AHRI Standard 1060.

H. DX Cooling Coil

1. DX refrigerant coils shall be AHRI Certified and shall be silver soldered or brazed into the compressed refrigerant system. Coil shall be constructed of copper tubing permanently bonded to aluminum fins and enclosed in a galvanized steel frame. If two compressors are used as components of a packaged DX system in the unit, then the evaporator coil shall be of the “interlaced” configuration, permitting independent operation of either compressor without conflict with the other compressor.

I. Reheat Coil

1. DX reheat coil with factory installed modulating hot gas reheat valve for humidity control. Furnish coil with coating equal to Electro Fin.

J. DX Compressor/Condenser

1. Unit shall have dual integral hermetic scroll type compressors, dual condensing fans and shall include liquid line filter drier, thermostatic expansion valves, manual reset high- and low-pressure cutouts, and a crankcase heater. Condensing fans shall be furnished with automatic reset thermal protectors and shall be rated for continuous duty.

K. Supply Air blower assemblies

1. Blower assembly shall consist of an electric motor and direct-drive fans. Assembly shall be mounted on heavy gauge galvanized steel rails and further mounted on 1.125-inch-thick neoprene vibration isolators. Blower motors shall be capable of continuous speed modulation and controlled by a VFD.

L. Exhaust Air blower assemblies

1. Blower assembly shall consist of an electric motor and a direct-drive fan. Assembly shall be mounted on heavy gauge galvanized steel rails and further mounted on 1.125 inch thick neoprene vibration isolators. Blower motor shall be capable of continuous speed modulation and controlled by a VFD.

M. 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 rust inhibiting paint.
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. Motors and blowers are to be mounted on common frame, isolated from the unit case with seismic restrained and flexible duct connections. Motors and blowers shall have V-belt drives with variable pitch sheaves. **Furnish a spare set of belts for all belt drive fans and the energy wheel (as applicable).**

M. Gas Heater

1. Provide a self-contained, indirect fired, minimum 79% efficient, automatically controlled gas fired heater with output capacity as specified. The combustion chamber shall be fabricated of type 409 stainless steel. The flue gases shall pass through a stainless steel one pass tubular economizer. Gas heater shall be U.L. and E.T.L. listed.
2. All economizer tubes shall be accessible for cleaning through an external access panel. Access shall be located at the same end of the unit as the burner and flue outlet.

3. Motor starter, relays, transformer, switches, fuse holders, and sequencing controls shall be factory wired in conduit and mounted in enclosures. The entire unit shall operate automatically in accordance with the sequence of operations. A combination fan and limit control shall control the main blowers and operate to de-energize the burner if discharge air temperature becomes excessive.
 4. Factory installed induced draft blower shall be independently driven by single purpose self-ventilating motor and controlled separately from the main blowers. The design shall be such that cooling air is drawn over the inboard motor bearing and shaft.
 5. The power gas burner equivalent to Gordon Piat shall be factory mounted and wired. Provide high tension spark ignited gas pilot, electronic primary safety control, automatic gas control valve, main gas regulator, pilot gas regulator, pilot gas cock, pilot assembly, and all components necessary to make a complete unitary burner assembly.
 6. Provide 4:1 modulated firing including damper motor, gas metering valve, proportioning air damper and necessary linkage to assure proper air-fuel ratio at all rates. All components of the burner to be mounted, wired and fire tested prior to shipment from the manufacturer.
- N. Unit shall have permanent 2-inch (50.8 mm) aluminum filters located in the outdoor air intake and shall be accessible from the exterior of the unit. MERV 8 disposable pleated filters shall be provided in the supply air stream. MERV 13 disposable pleated filters shall be provided in the supply final air stream and MERV 8 filters in the exhaust air stream.
- O. 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 120 VAC 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 120 VAC actuator with an end switch to be interlocked with the return air motor relay. Dampers shall have parallel blades.

5. Two Position Spring Return Actuators shall be 120 VAC 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 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.

P. Electrical

1. Electrical controls shall include motor VFDs, 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.

Q. Controls

1. Integral standalone microprocessor controller, programmable and adjustable with both Ethernet and RS-485 communication ports.
2. The control system shall include an onboard digital controller that indicates both owner-supplied settings and fault conditions that may occur. The programming shall include indication of the following faults:
 - a. Global alarm condition (active when there is at least one alarm)
 - b. Supply Air Proving Alarm
 - c. Supply airflow monitor and display
 - d. Exhaust airflow monitor and display
 - e. Compressor Trip Alarm
 - f. Compressor Locked Out Alarm
 - g. Supply Air Temperature Low Limit Alarm
 - i. Sensor #1 Out of Range (outside air temperature)
 - ii. Sensor #2 Out of Range (supply air temperature)

- iii. Sensor #3 Out of Range (cold coil leaving air temperature)
- 3. 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.
- 4. Remote Interface
 - a. Furnish, install, and wire a Remote Interface. (RI) This device shall allow users to change all unit operating parameters, execute schedules, and change control program variables. The panel shall be wall-mounted and NEMA 4 construction. Install where indicated on the plans.
 - b. **NOTE: Wiring from the ERV to the Remote Interface Panel shall be furnished by the ERV manufacturer and installed by the Electrical Contractor. The Electrical Contractor shall furnish and install conduit from the ERV to the Remote Interface Panel for this wiring.**
 - c. Furnish and install a manual occupied/unoccupied switch next to the Remote Interface and wire from the RI to the occupied/unoccupied switch.
- 5. Units with heat wheels shall come with factory mounted electronic speed control providing soft-start/stop, rotation detection and alarm, and self-cleaning jog functions.
- 6. 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. 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.
 - c. Gas Heater shall be provided with 4:1 stepped controls by the DDC control board. The heater shall control supply air temperature in sequence with the heat recovery wheel.
 - d. Blowers shall be provided with motor starters with overloads controlled by the microprocessor.

2.06 ELECTRIC UNIT HEATERS

- A. Provide propeller type electric unit heaters as manufactured by Marley, Indeeco, Qmark, Electromode, or approved equal designed for horizontal. Heaters shall be

of the draw-through air flow design to eliminate element hot spots and extend design life. Units shall be UL listed, and shall comply with National Electrical Code and OSHA requirements.

1. Casing

- a. Cabinet shall be made of not less than 22 gauge die formed cold rolled steel with smooth contours and minimization of exposed fasteners. All metal surfaces of the enclosure shall be cleaned of all oils and phosphate coated to resist corrosion, then finished in a electrostatically applied decorative baked enamel for optimum corrosion protection.
- b. Individual adjustable louvers with 30 degrees downward stops shall be furnished to provide desired control of discharge air.
- c. Mounting brackets designed for either ceiling or wall swivel mounting shall be furnished.

2. Heaters

- a. All heaters shall be UL Listed and meet the requirements of the National Electrical Code. The electric heating bank shall consist of metal sheath heating elements. The elements shall consist of 80/20 Ni-chrome wire and have a copper clad steel sheath for strength and corrosion resistance, and aluminum fins. The heating bank shall have protective air inlet louvers. All heaters drawing in excess of 48 amperes shall be provided with factory installed subdivided and fused circuits of 48 amperes or less.

3. Fan/Motor Assembly

- a. Each unit shall have a single motor and direct drive propeller fan completely factory assembled and resiliently mounted. Motor shall be totally enclosed. Single phase motors shall be equipped with thermal overload protection. Fans shall be aluminum. Fans shall be statically and dynamically balanced for quiet operation. Propeller fan shall be equipped with a safety fan guard.

4. Controls

- a. Provide 120 volt control transformer and contactor. All controls shall have pig tails and spade terminals for ease of wiring to centrally located terminal board.

- b. Heaters shall be equipped with automatic reset thermal overload protection of the linear capillary type wired for instantaneous de-energizing in case of the thermal overload.
 - c. Fans shall have delay on both start and stop. Upon call for heat, fan start shall be delayed until heating element is warm. When thermostat is satisfied, fan stop shall be delayed until heating element is cool.
 - 5. Accessories: Factory furnished and installed disconnect switch.
- B. QWD Series washdown heater is a reliable, rugged, self-contained, U.L. and CSA listed, corrosion resistant unit heater. This unit offers both corrosion protection in harsh environments and the ability to be hosed down for cleaning.
 - 1. All components are designed to be moisture and corrosion resistant. A sturdy stainless steel case surrounds industrial grade 316 stainless steel finned tubular elements. The motor is a totally enclosed, permanently lubricated, ball bearing type which is epoxy painted for moisture and corrosion resistance. The junction box which houses the built-in controls and element terminals is rated NEMA 4X. Air flow comes from a spark resistant, epoxy coated aluminum fan. Accessories: Power contactor, epoxy sealed automatic over-temperature cutout, internal thermostat (55F - 105F), pilot light to indicate when unit is in operation mode, and selector switch are standard (heater on, off, fan only).
 - 2. Accessories: Factory furnished and installed disconnect switch. Monel Elements. Secondary manual reset limit. Remote wall mount thermostat.

2.07 DUCTWORK

- A. Provide all sheet metal ductwork required for the various supply and exhaust air systems. **Unless otherwise indicated on the Contract Drawings ductwork shall be 316 stainless steel and all ductwork and sheet metal plenums shall be constructed meeting the requirements of ASTM A 480, 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), 3 inch water gauge Pressure Class.
- B. 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.

2.08 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 and where noted within the Contract Drawings and these specifications.
 2. Dampers less than 12 inches in height shall be equal to 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. Diffusers, Registers and Grilles

1. Supply Grille, Supply Register:
 - a. Aluminum heavy duty construction.
 - b. 1 1/4-inch margins, mitered corners, and countersunk mounting holes.
 - c. Double deflection.
 - d. Vertical front blades and horizontal rear blades.
 - e. Individual adjustable front and rear blades on 1-1/2 inch centers.
 - f. Mill finish.
 - g. Register to be provided with integral opposed blade type steel damper adjustable from face.
2. Supply Diffuser
 - a. Aluminum construction.
 - b. Adjustable pattern vanes on all four sides for horizontal to vertical throw discharge.
 - c. Spring loaded removable core.
 - d. White enamel finish.
 - e. Round neck.
 - f. Diffuser to be provided with integral opposed blade type steel damper adjustable from face.
3. Exhaust Registers, Exhaust Grilles:
 - a. Aluminum heavy duty 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 steel damper adjustable from face.

F. 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. 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. Actuators shall be 120 VAC.

2.09 INSULATION

- A. All insulation, adhesives, tape, etc. shall conform to NFPA 90A. No voids in insulation will be permitted.
- B. Pipe Insulation.
 1. 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.
 2. Insulation shall comply with ASTM E84 or UL 723.

3. 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.
4. Insulation shall include antimicrobial protection for the inhibition of mold and mildew growth.
5. Installation shall meet manufacturer's recommendations. Seal butt joints with insulation manufacturers approved adhesive.
6. 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.

C. Duct Insulation

1. Supply ductwork shall be multi-layered from 1" thick, semi rigid fibrous glass boards to provide an aggregate insulation value of R-12. Cover with factory applied fire retardant foil reinforced kraft vapor barrier facing on outer layer. Outdoor ductwork (if applicable) shall be jacketed and insulated to R-12 using semi-rigid fibrous glass boards with fire retardant foil-reinforced vapor barrier and a waterproof jacket and coating equal to Venture Clad 1577CW.
2. Insulation density shall be 3 lb./cf with maximum K factor of 0.23 at 75°F mean temperature. Insulation value shall be equal to R-12.
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°mited. 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.

2.10 AUTOMATIC CONTROLS

- A. The Contractor shall furnish, install or provide electric automatic control devices as indicated on the Drawings and in the Specifications.
- B. Provide:
 1. Automatic damper actuators (if not furnished with equipment).
- C. Furnish:
 1. Integral Controller for Rooftop Energy Recovery Unit.
 2. Remote User Interface for Rooftop Energy Recovery Unit.
 3. Sensors as noted below.
 4. Wall mounted thermostats for Electric Unit Heaters.
- C. Install:
 1. All sensors, user interfaces etc. for Rooftop Energy Recovery Unit supplied as field installed devices.
- D. Submittals
 1. The following shall be submitted for approval:
 - a. Data sheets for control system components.
- E. Instruction and Adjustment
 1. Upon Completion of the Work, the Contractor 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 Owner's 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. 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.

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. Provide electric spring return actuators. Spring return actuators shall be direct coupled type equal to Belimo which require no crankarm and linkage and be capable of direct mounting to the damper jackshaft. 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. 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. Actuators shall function as required within 85% to 110% of their power supply rating. 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 shall be UL listed and CSA certified, have a 5-year warranty, and be manufactured under ISO 9001 International Quality Control Standards. Actuator voltage shall be 120VAC - confirm with DIVISION16 prior to ordering actuators.

I. Sensors

1. Space Temperature Sensor
a. 120 VAC

- b. 40 to 100°F Temperature Range
 - 2. Outdoor Air Temperature Sensor
 - a. 120 VAC
 - b. -30 to 110°F Temperature Range
 - 3. Supply Air Temperature Sensor
 - a. 120 VAC
 - b. 40 to 100°F Temperature Range
 - 4. Energy Wheel Rotation sensor
 - 5. Building Pressure Sensor
 - a. 120 VAC
 - b. -0.1 to +0.1" w.c. Pressure Range
- J. Remote User Interface
 - 1. Contractor shall furnish and install a Remote Interface that functions as a remote indicator of owner-selected operating parameters and permits remote inputting of new operating parameters. The RUI shall include an integral space temperature sensor. Remote panel shall have a large LCD user interface screen similar in form and function to the screen on the DDC. Install where shown on plans.

2.11 CONTROL SEQUENCES

- A. Control sequences of operation shall be as indicated as follows:
 - 1. Rooftop Energy Recovery Unit:
 - a. The following sequence of control shall be programmed into the controller by the manufacturer at the factory.
 - b. The unit shall be started manually and run continuously until manually shut off. The supply and exhaust fans shall be controlled by a building pressure sensor to maintain a neutral space pressure (0.0" w.g.) in the Pump Room.
 - c. The unit's programmable DDC controller shall modulate the heat recovery wheel and gas heat in sequence to control the space air temperature. Space air temperature is reset between occupied (60-degrees) or unoccupied (50-degrees) temperature setpoints by a remote two-position switch. Space temperature shall be sensed by an integral temperature sensor in the Remote User Interface.
 - d. Refer to the specifications for internal control sequences for dampers and the heat recovery wheel that can be accessed through the unit's panel mounted touch screen.

2. Electric Unit Heaters shall be controlled by wall mounted thermostats to maintain a space temperature setpoint of 50 deg F. (adjustable)

3.00 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 CUTTING AND PATCHING

- A. Do all cutting and patching required except cutting and patching of finish (visible) materials. Concrete cutting shall be done with abrasive wheels or saws, and coring with a diamond core bit. Jackhammers are prohibited.

3.03 CONNECTIONS TO EQUIPMENT

- A. 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.

3.04 SUPPORTS

- A. General

Hangers used to support piping 2 inches and larger shall be fabricated to permit adequate adjustment after erection while supporting the load.

- B. Energy Recovery Unit: HVAC Contractor shall coordinate with Roofing Contractor to ensure curb is properly flashed to roof for a water/weather tight installation.

- C. 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.

3.07 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.
- C. Power Transmission Components Adjustment: V-belts and sheaves shall be tested for proper alignment and tension prior to operation and after 72 hours of operation at final speed. Belts on drive side shall be uniformly loaded, not bouncing. Alignment of direct driven couplings shall be to within 50 percent of manufacturer's maximum allowable range of misalignment.

3.08 AIR 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 systems shall be complete and operable with registers, ducting, diffusers, returns, 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. Air Systems
 - 1. Each system shall be adjusted until all flow quantities are within plus 10% and minus 0%. 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.

3.09 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. 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.

3.10 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.
- 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.

3.11 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.

3.12 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.

3.13 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 ductwork from discharge of Rooftop Energy Recovery Unit to supply outlet to a value of R-12.
- 2. Insulate inside of Rooftop Energy Recovery Unit roof curb with rigid insulation with a value of R-12.
- 3. 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.
- 4. 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.
- 5. 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.

6. 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.
 7. 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.
 8. 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.
 9. 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.
 10. 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.

3.14 OPERATING AND MAINTENANCE INSTRUCTIONS

- A. Operation and Maintenance Manuals shall be provided in accordance with Section 01730 and this section of the specifications.
- 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, 3 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.

3.15 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

THIS PAGE INTENTIONALLY LEFT BLANK

DIVISION 16

THIS PAGE INTENTIONALLY LEFT BLANK

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. Complete electrical building service as hereinafter specified.
 - 2. Conduit, wire and electrical connections are required on certain items specified in sections of these specifications other than the electrical section. The Contractor shall examine all sections of these specifications to determine the complete scope of the Electrical Work.
 - 3. Raceways and fittings
 - 4. Wires and cables
 - 5. Variable Frequency Drives
 - 6. Miscellaneous equipment
 - 7. Switchboards
 - 8. Panelboards
 - 9. Lighting systems
 - 10. Generator
 - 11. Grounding systems
 - 12. Underground system
 - 13. Fire/Security Alarm system
 - 14. Communication system
 - 15. Demolition of Electrical Systems
 - 16. Temporary Service

- 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/control wiring for all HVAC (Heating, Ventilation and Air Conditioning), plumbing and fire protection equipment furnished under other Divisions of these Specifications.
- H. Install and wire all thermostats, controllers and other devices furnished under other Divisions of these specifications which directly control HVAC equipment.

1.02 SUBMITTALS

- A. Submit the following in accordance with Section 01300:
 - 1. Circuit breakers
 - 2. Variable Frequency Drives
 - 3. Dry type transformers
 - 4. Switchboards
 - 4. Panelboards
 - 5. Generator
 - 6. Lighting fixtures
 - 7. Disconnect switches
 - 8. Control stations
 - 9. Miscellaneous equipment
 - 10. Security 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. No material shall be ordered or shop Work started until the Engineer's approval of shop drawings has been given.
- E. 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.
- F. Operation and Maintenance Manuals - Prepare manuals in accordance with Section 01730.
- G. 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. Service and Metering
 - 1. The power company serving this project is Eversource, Work Order #6603570.
 - 2. The existing service shall be replaced with a new service that will be obtained at 480/277Volts, 3-phase, 4-wire from a new utility pole and new pole mounted transformers provided by the utility company.

3. The existing service shall be utilized for a temporary service for power to the By-Pass Pumping system and existing pump station. Coordinate with Eversource for the installation of the temporary service equipment.
4. Furnish and install the secondary service conduit, wire and connectors.
5. Eversource will provide the meter. The Contractor shall provide the meter socket and install all the metering equipment in accordance to the utility company requirements.
6. All Work and material for the electrical service shall be in accordance with the requirements of Eversource.
7. Make all arrangements with the Eversource for obtaining each service and furnish all labor and material for the services. Submit any utility fee invoice(s) associated with the service replacement to the Owner. The Owner shall make direct payment(s) for the fee(s) to Eversource.

C. 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 with the City of Framingham

D. Tests and Settings

1. Test all systems furnished 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

A. Excavation and backfilling, including gravel or sand bedding for underground Electrical Work is specified under DIVISION 2 - SITE WORK of these Specifications.

B. Concrete Work, including concrete electrical duct encasement, is specified 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. Locate all necessary slots for Electrical Work and form before concrete is poured.

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 Contractor at no additional cost to the Owner.

1.08 CORING

A. Provide all coring for conduits penetrating floors, walls, partitions etc.

1.09 SUPPLEMENTARY SUPPORTING STEEL

A. Provide all supplementary steelwork required for mounting or supporting equipment and materials.

B. Steelwork shall be firmly connected to building construction as required.

C. Steelwork shall be of sufficient strength to allow only minimum deflection in conformity with manufacturer's published requirements.

D. All supplementary steelwork shall be installed in a neat and workmanlike manner parallel to floor, wall and ceiling construction; all turns shall be made at forty-five and ninety degrees, and/or as dictated by construction and installation conditions.

- E. All manufactured steel parts and fittings shall be galvanized steel for NEMA 12 Areas and stainless steel for NEMA 4X and NEMA 7 areas.

1.10 ELECTRICAL HAZZARDOUS CLASSIFCATION AND NEMA RATINGS FOR ELECTRICAL INSTALATION AND ENCLOSURES

- A. Unclassified, NEMA Type 12 for Building interior.
- B. Unclassified, NEMA Type 4X for Building exterior.
- C. Class 1, Division I, NEMA Type 7 for inside and 18” above the Wet Well.

1.11 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.
- 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 by the Contractor.
- 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 at no additional cost to the Owner.

- 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.

1.12 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.

1.13 TEMPORARY POWER AND LIGHTING

- A. The Contractor shall furnish and install feeders of sufficient size from the utility company 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 Contractor.
- C. The Contractor 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. 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.
- E. All temporary wiring and accessories thereto installed by the Contractor shall be removed after their purposes have been served.
- F. The Contractor will pay for the cost of electric energy consumed.
- G. 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 hours before and 2 hours after a normal eight (8) hour working day. In addition to the above, provide and maintain, to the satisfaction of the Owner, all temporary lighting and power that may be required for safety purposes.

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.

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. Generator.
 - 2. Automatic Transfer Control System.
 - 3. Variable Frequency Drives.
 - 4. Security System.
 - 5. 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 variable frequency drives 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 rods
 - 4. 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 GROUND RODS

- A. Ground rods shall be copper clad steel 3/4 inch in diameter and 10 feet in length unless otherwise shown on the drawings. Rods shall one 10 foot length rod. Ground rods shall be Copperweld, equal by A.B. Chance Co., or equal.

2.04 GROUNDING BUS BARS

- A. Grounding bus bars shall be copper, not less than 1/4 inch by 2 inch by 24 inch.
- B. All lugs, bolts and nuts shall be silicon bronze.
- C. Bus bars to be securely mounted to room wall with brackets and insulators.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. Grounding electrode conductors shall be run in rigid steel conduits. Protecting conduits shall be bonded to the grounding electrode conductors at both ends.
- B. Grounding conductors shall be run with feeders where shown on the drawings or hereinafter specified.
- C. 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.
- D. Connect the following equipment by separate wire or cable directly to the grounding grid system:
 - 1. Frame of each transformer
 - 2. Neutral of each transformer
 - 3. Service entrance circuit breaker
 - 4. Ground buses
 - 5. Metal Fencing
 - 6. Generator Enclosure
 - 7. Door frames and railings.
- E. Connect the following equipment by separate wire or cable to the ground bus in the distribution equipment servicing the equipment:
 - 1. Switchboard
 - 2. Panelboards
 - 3. 480 Volt motors
 - 4. Control panels
 - 5. All feeders and branch circuits
 - 6. Receptacle 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. Bond the following N.E.C. approved electrodes together to form a ground grid system:
 - 1. Metallic water main
 - 2. Building steel frame
 - 3. Steel reinforcing rods within concrete at 4 ft. intervals.
 - 4. Grounding rods and buses

5. Buried bare copper conductors

- H. Grounding electrodes shall be driven where shown on the drawings. Spacing between electrodes shall be twice the length of the electrodes.
- I. 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.
- J. All buried connections shall be made by a thermic welding process equal to Cadweld. Molds used for the welding process shall be new having no prior usage. Molds shall be the specific type for the connection to be made.
- K. Light fixture bases shall be furnished with a grounding point.
- L. All buried conductors shall be laid slack in trenches. The earth surrounding the cables shall be void of sharp objects which may injure the cables. Backfill material shall be natural earth. Where cables are exposed to mechanical injury they shall be protected by pipes or other substantial guards. If guards are iron pipe or other magnetic material, conductors shall be electrically connected to both ends of the guard. Connections shall be made as hereinbefore specified.
- M. Do not allow water main connection to be painted. If the connections are painted, they shall be disassembled and remade with new fittings.

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 16080

UNDERGROUND SYSTEMS

1.00 PART 1 – GENERAL

1.01 SCOPE

- A. The work of this section includes furnishing and installing of a complete underground system of raceways, handholes, and frames and covers as specified herein and as shown on the drawings.

1.02 SUBMITTALS

- A. Submit the following in accordance with Section 01300:
 - 1. Raceways
 - 2. Handholes, frames and covers
 - 3. Warning Tape

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.

2.00 PART 2 – PRODUCTS

2.01 RACEWAYS

- A. Raceways shall be PVC schedule 40 conduit. Raceway materials shall be in accordance with Section 16130 (Raceways and Fittings).

2.02 CONCRETE HANDHOLES, FRAMES AND COVERS

- A. Electric Hand holes shall be either precast or cast in place steel reinforced concrete per details in contract drawings, concrete to have minimum strength of 5000 psi after 28 days.
- B. Hand holes frame and covers shall be steel and meet or exceed the Tier H-20 load requirements set forth in the American National Standards Institute's ANSI/SCTE 77. The frame shall be securely bolted to handhole with stainless steel bolts and the cover be embedded with the following logs:
 - 1. "ELECTRICAL" logo for electrical power applications

2.03 DETECTABLE METTALIC WARNING TAPE

- A. Warning tape shall be red laminated covered aluminum core, 5mil thickness, 2 inch minimum width.

3.00 PART 3 – EXECUTION

3.01 INSTALLATION

- A. Raceways shall be installed to drain away from buildings. Raceways between handholes shall drain toward the handholes. Raceway slopes shall not be less than 3 inches per one hundred feet.
- B. Raceway banks shall be encased in concrete. Concrete shall be reinforced with steel rods.
- C. Plastic spacers shall be used to hold raceways in place. Spacers shall provide not less than two inch clearance between raceways.
- D. The minimum cover for raceway banks shall be 30 inches unless otherwise permitted by the Engineer.
- E. Raceway entrances to buildings and structures shall be made with steel conduit not less than ten feet long.
- F. Conduits in duct banks entering buildings and structures shall be spread to allow adequate room for conduit wall seals, pull and terminal boxes.
- G. Where bends in raceways are required, long radius elbows, sweeps and offsets shall be used. Sweeps at riser pole shall be rigid steel encased in concrete.
- H. All raceways shall be swabbed clean before cable installation.
- I. Spare raceways shall be plugged and sealed watertight at all buildings and structures.
- J. Raceways in use shall be sealed watertight at all buildings and structures.
- K. Rigid steel conduit shall be used for risers at the service pole and other locations shown on the drawings. Conduit sweep at pole base shall be rigid steel conduit.
- L. Raceway terminations at manholes shall be with end bells.
- M. Pulling-in irons shall be installed opposite all raceway entrances to manholes.
- N. All underground metallic conduit run underground in direct contact with earth shall be coated with asphaltum or bitumastic varnish or similar corrosion protection the entire length of the run.

- O. All underground raceways/ductbanks shall be marked with warning tape located approximately 12 inches below grade above the raceway/ductbank.
- P. Refer to paragraph titled "Conduit Embedded in Slabs" in Section 16050 (Electrical General Conditions).

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

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. Manual transfer switch
 - 2. Generator docking station
 - 3. Surge Suppression Devices
 - 4. Disconnect switches
 - 5. Motor starters
 - 6. Transformers
 - 7. Circuit breakers
 - 8. Enclosure types
 - 9. Wireway
 - 10. Nameplates
 - 11. Meter Socket
 - 12. Floor Mats
- 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

2.02 MANUAL TRANSFER SWITCHES

- A. The manual transfer switch shall be UL 1008 listed, designed for an emergency and normal source of 480 Volts, 3 Phase, 4 Wire, 60 Hertz. Current ratings shall be as indicated on the drawings.
- B. Each switch shall be mounted in a NEMA 12 wall mounted enclosure
- C. The transfer switch shall be of double throw contact construction with an 3-position emergency-off-normal external handle.

2.03 GENERATOR DOCKING STATION

- A. Docking station shall include 16 Series Camlok Panel Mounts for use as connection to portable generator.
- B. Entire package must be listed to ETL or UL 1008 Standards. UL listing of individual components is not acceptable.
- C. Enclosures:
 - 1. NEMA 3R rain-tight, aluminum enclosure
 - 2. Pad-lockable front door shall include a hinged access plate at the bottom for entry of cables from portable generator or portable load bank. NEMA 3R integrity shall be maintained with access plate open for cable entry.
 - 3. Front and side through a front access panel shall be accessible for maintenance.
 - 4. Top, side, and bottom through a front access panel shall be accessible for permanent cabling.
- D. Phase, Neutral, and Ground Buses:
 - 1. Material: Silver-plated Copper
 - 2. Equipment Ground Bus: bonded to box.
 - 3. Isolated Ground Bus: insulated from box.
 - 4. Ground Bus: 50% of phase size.
 - 5. Neutral Bus: Neutral bus rated 100 percent of phase bus.

- E. Generator connectors shall be male Camlok style mounted on gland plate, color coded according to system voltage
 - 1. A phase – Black or Brown
 - 2. B phase – Red or Orange
 - 3. C phase – Blue or Yellow
 - 4. N Neutral – White
 - 5. G Ground – Green
- F. Temporary connectors shall include protective flip lids to prevent accidental contact.
- G. Permanent connectors shall be broad range set-screw type, located behind an aluminum barrier.
- H. Short Circuit & Withstand Rating: 65KAIC.
- I. Panel mounted Phase monitoring relay.
- J. Power Cables:
 - 1. Provide power cables for each phase, ground, and neutral connection with pre-wired color coded male and female Camlok connectors at each cable end.
 - 2. Cable to be UL type W portable power cable with copper conductors insulated with synthetic rubber (EPDM). The cable is to be covered with a black CPE rubberjacket applied in two layers with reinforcement placed between the layers.
 - 3. Cable and plug assembly to have full rated capacity of the Generator Docking Station.
 - 4. All cables shall have a minimum length of 25 feet.

2.04 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.

B. Telephone Service TVSS

1. Telephone system protection, high speed, fused, solid state design shall be provided on the incoming telephone service line.
2. UL 497A listed, low capacitance type, with female jacks, input and output.

2.05 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, and 4X enclosures shall be as specified herein.
- D. Disconnect switches shall be as manufactured by Square D, ABB, or General Electric Co.

2.06 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 and 4X enclosures shall be as specified herein.
- F. Disconnect switches shall be provided by Square D, ABB, or General Electric Company.

2.07 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 and 4X enclosures shall be as specified herein.
- D. Provide handle guard kit with padlock provisions.
- E. Manual motor starters shall be as manufactured by the Square D, ABB, or General Electric Co.

2.08 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.

2.09 ENCLOSED CIRCUIT BREAKERS

- A. Circuit breakers shall be molded case, three pole unless otherwise noted, with voltage rating as required. Ampere rating shall be as shown on the drawings. Provide with service entrance rating where required.
- B. Main breaker shall be solid state with digital trip and adjustable trip setting with LED on face of breaker providing amps per phase. Provide auxiliary contacts for trip status to remote alarm.
- C. The interrupting capacity shall be not less than 65,000 Amperes, RMS symmetrical at 480V AC.
- D. All circuit breakers with 225 Ampere frames and larger shall have interchangeable trips.
- E. Enclosure shall meet the area NEMA designation for which they are located.
- F. NEMA Type 12 and 4X enclosures shall be as specified herein.

2.10 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.
- D. All metal enclosures shall be finish painted over a rust inhibiting primer.

211 WIREWAY

- A. Wireway shall be steel.

- B. Wireway shall be manufactured by General Electric Co., or equal by Siemens Corp or Hoffman Enclosures.

2.12 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.

2.13 METER SOCKET

- A. Provide a utility meter socket in a NEMA 3R enclosure with HASP cover provision of the type approved by the utility company.
- B. Meter Socket shall be 7 terminal, 320 Amp continuous rated, self-contained ringless type meter socket with a manual single handled bypass with locking jaw and safety arc shield.

2.14 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.

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.

3.02 TESTS AND CHECKS

- A. The following minimum tests and checks shall be made before energizing the automatic transfer switch.
1. Perform insulation resistance tests phase-to-phase and phase-to-ground with switch in both source positions. The Insulation resistance test voltages and minimum values to be in accordance with manufacturer's published data.
 2. Measure contact resistance in normal and alternate source position.
 3. Determine contact resistance in micro-ohms. Investigate any value exceeding 500 micro-ohms or any values which deviate from adjacent poles by more than fifty percent (50%).

-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 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 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.

2.05 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. Each branch circuit shall have a dedicated 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.

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.

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

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.

1.02 SUBMITTALS

- A. Submit the following in accordance with Section 01300:
 - 1. Raceways.
 - 2. Cable Tray
 - 3. 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 all wet wells.
- 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 conduit, 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. Terminal boxes, cabinets, junction boxes, pull boxes and wireways used in areas designated as NEMA 4X shall be stainless steel 316, gasketed.
- H. Combination expansion-deflection fittings shall be used where conduits cross structure expansion joints. Refer to Structural drawings for expansion joint locations.
- I. Conduit wall seals shall be used where underground conduits penetrate walls or at other locations shown on the drawings.
- J. Fire stops shall be used where cables or conduits penetrate through fire resistant rated walls, floors, ceilings or partitions, including the wall, floor and ceiling openings of the electrical room.
- K. 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. Cable Tray System

1. Cable tray shall be aluminum ladder type with 6 inch rung spacing and no cover.
2. Unless otherwise noted, all cable tray system components including, but not limited to, straight sections, fittings, hangers, splice plates and reducers shall be aluminum.
3. The cable tray shall be capable of supporting the total cable load with a maximum deflection of not more than 1/200 of the span with a safety factor of 1.5 based on the destructive load, regardless of the location of splice plates or type of span.
4. Cable trays shall be four inches in depth.
5. Standard rigid fittings shall be aluminum and used at all changes in direction or size of the cable tray system.
6. Cable trays and accessories shall be supplied by a single manufacturer and shall be as manufactured by Globe Metal Products Division of United States Gypsum Company, B-Line Systems, Inc., Chalfant Cable Tray Systems, or equal.
7. All fastening hardware (nuts, bolts, hangers, rods, washers, etc.) shall be stainless steel.
8. Ninety degree sweeps shall have the following minimum radius:
 - a. For trays 9 inch to 18 inch in width - 12 inch radius.
 - b. For trays 24 inch in width - 18 inch radius.
 - c. For trays 30 inch and greater - 24 inch radius.
9. Provide ladder drop out fittings at all pump cable entry locations.

D. Flexible couplings shall be as manufactured by Crouse-Hinds Co., Appleton Electric Co., O.Z. Manufacturing Co., or equal.

E. 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 same thickness as used on the coated steel conduit.
 4. 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.
 5. PVC boxes and fittings shall be as manufactured by Carlon, An Indian Head Co., O.Z. Manufacturing Co., or equal.
 6. 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.
 7. Conduit hubs shall be as manufactured by Myers Electric Products, Inc., Raco Div., O.Z. Manufacturing Co., or equal.
 8. Conduit wall seals shall be Type WSK as manufactured by O.Z. Manufacturing, Co., or equal by Link Seal Co.
 9. Combination expansion-deflection fittings shall be Type XD as manufactured by Crouse-Hinds Co., or equal by Appleton Electric Co., O.Z. Manufacturing Co.
 10. Conduit seal bushings shall be Type CSB as manufactured by O.Z. Manufacturing Co., or equal by Crouse-Hinds Co.
 11. Fire stops shall be Type CFSF as manufactured by O.Z. Manufacturing Co., or equal by Crouse-Hinds Co., Appleton Electric Co.
 12. 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.
- F. 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.
- G. 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.

- H. 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.

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 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 encased in concrete envelope shall be run in direct line with bends of largest possible radius.
- Q. 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.
- R. A ground wire shall be run in all runs of electric metallic tubing and PVC conduit.
- S. All bends in PVC conduit shall be made using a hotbox and bending guide tool.
- T. 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 16441

SWITCHBOARD

PART 1 – GENERAL

1.01 DESCRIPTION

- A. The work of this section includes the furnishing, installing and testing of service entrance rated switchboard, circuit breakers, and automatic transfer control system assembly including all required control devices and specified to be part of the equipment as specified herein and as shown on the drawings.

1.02 SUBMITTALS

- A. Manufacturer's literature and brochures shall be submitted for all items to be furnished in accordance with Section 01300.
- B. Submittals required under this section include, but are not limited to the following:
 - 1. Drawings shall include front and side enclosure elevations with overall dimensions shown; conduit entrance locations and requirements; nameplate legends; one-line diagrams; equipment schedule; and switchboard instrument wiring and device details.
 - 2. Provide drawing showing space for all incoming cables as shown on the Electrical Contract Drawings.
 - 3. Complete factory wiring diagrams, and elementary or control schematics, including coordination with other electrical control, metering and protective devices operating in conjunction with the switchboards.
 - 4. Due to the complexity of the switchboard operation, 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.
 - 5. Bill-of-material listing conductor material and insulation type as well as other hardware and equipment to be furnished.
 - 6. Catalog cut sheets and other necessary information on each device (relay, switch, instrument transformers, meter, circuit, breaker etc.) furnished and installed in or on the switchboard, to describe operating characteristics completely
 - 7. Where it is not explicitly shown and completely obvious from the outline drawings the following items shall be verified in a written statement accompanying the submittal.
 - a. Type of terminal blocks.

- b. Silver plating of bus
 - c. Insulation and isolation of bus
 - d. U.L. approval
- 8. Clear and concise information for storage, installation, operation, and care of the equipment. Non-applicable portions of standard publications shall be so marked.
 - 9. Time current curves of each size and type of each overcurrent protective device.
 - 10. Submit with the delivery of the switchboard an Installation and Maintenance Manual and one (1) copy of the manufacturer's drawings per shipping block.

1.03 REFERENCES

- A. The equipment in this specification shall be designed and manufactured according to latest revision of the following standards (unless otherwise noted).
 - 1. ANSI/IEEE/NFPA 70 - National Electrical Code.
 - 2. Federal Specification W-C-375, Rev. B, Amend. 1, Circuit Breakers, Molded Case; Branch Circuit and Service.
 - 3. NEMA AB 1, Molded Case Circuit Breakers and Molded Case Switches.
 - 4. NEMA AB 3, Molded Case Circuit Breakers and Their Application.
 - 5. NEMA AB 4, Guidelines for Inspection and Preventive Maintenance of Molded Case Circuit Breakers Used in Commercial and Industrial Applications.
 - 6. NEMA PB 2.1, General Instructions for Proper Handling, Installation, Operation and Maintenance of Deadfront Distribution Switchboards Rated 600 Volts or Less.
 - 7. NEMA SG 3, Low Voltage Power Circuit Breakers.
 - 8. UL 1012, Power Units Other Than Class 2.
 - 9. UL 489, Molded-Case Circuit Breakers and Circuit-Breaker Enclosures.
 - 10. UL 891, Dead-Front Switchboards.
 - 11. ANSI/NEMA ICS 6 - Enclosures for Industrial Controls and Systems.
 - 12. NEMA 250 Enclosures for Electrical Equipment.
 - 13. NEMA ICS 2 - General Standards for Industrial Control Systems.

14. NEMA ICS 3 - Standards for Industrial Control Devices, Controllers and Assemblies.
15. NEMA ST 20 - Dry Type Transformers for General Applications.
16. UL 508 - Industrial Control Equipment.

1.04 PACKING/SHIPPING

- A. The Switchboard shall be separated into shipping blocks as required.
- B. Provide one (1) set of installation and maintenance instructions with each switchboard. Instructions are to be easily identified and affixed within the incoming or main section of the line-up.
- C. Shipping blocks shall be shipped on their sides to permit easier handling at the jobsite. Each shipping block shall include a removable lifting angle, which will allow an easy means of attaching an overhead crane or other suitable lifting equipment.

1.05 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.
- C. Prior to placing into service reasonably, store all equipment in a clean and dry enclosed space free from temperature extremes. Acceptable storage temperatures are from 50° F to 94° F, Provide power and space heaters where necessary to maintain heated environment to prevent moisture due to condensation.
- D. Maintain factory protection or cover with heavy canvas/plastic to keep out dirt, water, construction debris, and traffic.
- E. Handle in accordance with NEMA PB 2.1 and manufacturer's written instructions. Lift only by lifting means provided for this express purpose. Handle carefully to avoid damage to switchboard internal components, enclosure, and finish.

1.06 DESIGN CRITERIA

- A. The Switchboards shall be manufactured in an ISO 9001 certified facility. Manufacturer shall have specialized in the manufacture and assembly of low voltage Switchboards for 20 years.
- B. The manufacturing facility shall be registered by Underwriters Laboratories Inc.
- C. Make all necessary field measurements to verify that equipment shall fit in allocated space in full compliance with minimum required clearances specified in National Electrical Code. Switchboards submitted which do not adhere to the space shown on the

drawings shall be rejected and alternate manufacturer's equipment shall be submitted for review.

- D. Switchboards shall be inspected before shipment including structure, electrical conductors, bussing, general wiring, and devices.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

- A. General Electric Corporation
- B. Siemens
- C. Square D Corporation

2.02 ENCLOSURES

- A. The switchboards shall be dead-front front access switchboards conforming to NEMA PB 2 and labeled under UL 891. The switchboards shall be completely enclosed self-supporting metal structures with the required number of vertical panel sections, buses, molded-case circuit breakers, and other devices as shown on the drawings. Switchboards shall be fully rated for a short-circuit current of 100,000 symmetrical amperes RMS AC.
- B. Future Provisions: All unused spaces provided, unless otherwise specified, shall be fully equipped for future devices, including all appropriate connectors and mounting hardware.
- C. Enclosure shall be Type 1 - General Purpose, with incoming pull section bused to the main breaker section. The section shall have removable side covers for ease in installing and training the field cables and of sufficient depth for cable entry as shown on the Electrical Drawings.
- D. Sections shall be front aligned.
 - 1. Removable steel base channels (1.5 inch floor sills) shall be bolted to the frame to rigidly support the entire shipping section for moving on rollers and floor mounting.
 - 2. The switchboard enclosure shall be painted on all exterior surfaces. The paint finish shall be a medium gray, ANSI #49, applied by the electro-deposition process over an iron phosphate pre-treatment.
 - 3. All front covers shall be screw removable with a single tool and all doors shall be hinged with removable hinge pins.
 - 4. Top and bottom conduit areas shall be clearly indicated on shop drawings.
- E. Nameplates: Provide 1 inch high x 3 inches engraved laminated (Gravoply) nameplates for each device. Furnish black letters on a white background for all voltages.

- F. Bus Composition: Plating shall be applied continuously to all bus work. The switchboard bussing shall be of sufficient cross-sectional area to meet UL Standard 891 temperature rise requirements. The phase through-bus shall have an ampacity as shown in the plans. Tapered bus is not acceptable. Full provisions for the addition of future sections shall be provided. Bussing shall include all necessary hardware to accommodate splicing for future additions. ABC phasing should be in accordance with NFPA 70 front-to-back, top-to-bottom, and left-to-right.
- G. Bus Connections: Shall be silver plated and bolted with stainless steel bolts and conical spring washers.
- H. The buses shall be mounted on insulating supports of wet process porcelain, glass polyester, or suitable molded material, and shall be braced to withstand not less than 100,000 symmetrical amperes AC.
- I. Ground Bus: Minimum size 2 inches and sized per NFPA70 and UL 891 Tables 25.1 and 25.2 and shall extend the entire length of the switchboard. Provisions for the addition of future sections shall be provided.
- J. Provide removable side panels at main breaker for termination space of incoming service cables.

2.03 CIRCUIT BREAKERS

- A. Insulated case, RMS Main, Generator, and Tie circuit breakers.
 - 1. Circuit breakers shall be 100 % rated.
 - 2. The ampere rating of the circuit breakers shall be determined by the combination of an interchangeable rating plug, the sensor size and the long-time pickup adjustment on the circuit breaker. The sensor size, rating plug and switch adjustments shall be clearly marked on the face of the circuit breaker. Circuit breakers shall be UL Listed to carry 100% of their ampere rating continuously
 - 3. The following time/current response adjustments shall be provided. Each adjustment shall have discrete settings and shall be independent from all other adjustments.
 - a. Long Time Pickup
 - b. Short Time Pickup
 - c. Instantaneous Pickup
 - 4. Circuit breakers shall be equipped with auxiliary contacts and lockable handles.
 - 5. Circuit breakers shall be spring charged stored energy electrically operated type with manual pushbutton and remote control. Circuit breaker closures shall be interlocked so that only two of the circuit breakers (Main, Generator, and Tie) can be simultaneously in the closed position.

6. Terminations
 - a. All lugs shall be UL Listed to accept solid and/or stranded copper conductors. Lugs shall be suitable for 75° C rated wire.
- B. Group mounted distribution circuit breakers.
 1. Molded case type.
 2. Circuit breakers with frame rating of 250 Amps and greater shall have a solid state digital trip unit with adjustable long, short, and instantaneous trip settings. Circuit breaker with frame ratings less than 250 Amps shall have a thermal magnetic trip function.

2.04 DIGITAL POWER METER

- A. Switchboard 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.

2.05 AUTOMATIC TRANSFER CONTROL SYSTEM

- A. The switchboard shall be equipped with a PLC or microprocessor based Automatic Transfer Control System (ATCS) that monitors the incoming utility line and upon loss of utility power starts the generator and transfers the main bus from the Utility Breaker to the Generator Breaker.
- B. The complete ATCS shall be factory tested to ensure proper operation and compliance with the specification requirements. A copy of the factory test report shall be available upon request.

C. System Operation

1. When the voltage on any phase of the normal source drops below 80% or increases to 120%, or frequency drops below 90%, or increase to 110%, or 20% voltage differential between phases occurs, after a programmable time delay period of 0-9999 seconds factory set at 3 seconds to allow for momentary dips, the Main circuit breaker shall open and engine starting contacts shall close to start the generating plant.
2. The ATCS shall close the Generator circuit breaker when the emergency source has reached specified voltage and frequency on all phases.
3. After restoration of normal power on all phases to a preset value of at least 90% to 110% of rated voltage, and at least 95% to 105% of rated frequency, and voltage differential is below 20%, an adjustable time delay period of 0-9999 seconds (factory set at 300 seconds) shall delay transfer of the main bus back to the utility via the Main circuit breaker to allow stabilization of normal power. If the emergency power source should fail during this time delay period, the ATCS shall automatically the bus return to the bus to the utility source.
4. After retransfer of the bus to the utility power, the engine generator shall be allowed to operate at no load for a programmable period of 0-9999 seconds, factory set at 300 seconds.

D. Circuit Breaker Interlocking

1. The Main and Generator circuit breakers shall be interlocked so that only one of the circuit breakers can be connected to the main bus unless the Tie circuit breaker is in the open position.

2.06 WIRING

- A. All wiring shall be copper.
- B. Compartment wiring shall be no. 14 AWG minimum, and connected to compartment mounted, plug-in terminal blocks that allow compartments to be withdrawn without having to remove wires from fixed terminal blocks.
- C. Power wiring shall be black in color, control wiring shall be red in color.

2.07 FINISH

- A. All steel parts shall be provided with UL and CSA listed acrylic/alkyd baked enamel paint finish, except plated parts used in bus connections.
- B. All painted parts shall undergo a multi-stage treatment process, followed by the finishing paint coat.
- C. Pre-treatment shall include:

1. Hot alkaline cleaner to remove grease and oil.
 2. Iron phosphate treatment to improve adhesion and corrosion resistance.
- D. The paint shall be applied using an electro-deposition process to ensure a uniform paint coat with high adhesion.
- E. The standard paint finish shall be tested to UL 50 per ASTM B117 (5% ASTM Salt Spray) with no greater than 0.125 in (3 mm) loss of paint from a scribed line.
- F. Paint color shall be #61 light gray per ANSI standard Z55.1-967 (60-70 gloss) on all surfaces unless specified otherwise.

2.08 FACTORY QUALITY CONTROL

- A. The entire equipment shall go through a quality inspection and testing in accordance with NEMA PB 2 and the tests identified below before shipment. This inspection and testing will include:
1. Physical Inspection of Structure.
 - a. Bussing.
 - b. General wiring.
 2. Electrical Tests AC Dielectric Tests of:
 - a. Power circuits
 - b. Control circuits.
 3. Electrical Tests before shipment shall include:
 - a. Power circuit phasing.
 - b. Control circuit wiring
 - c. Instrument transformers
 - d. Meters.
 - e. Ground fault system.
 - f. Device electrical operation.
 4. Markings/Labels, include:
 - a. Instructional type.
 - b. Underwriters Laboratory (UL).

c. Inspector's stamps.

5. The manufacturer shall use integral quality control checks throughout the manufacturing process to ensure that the Switchboard meets operating specifications.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. The equipment shall be assembled on a smooth level raised concrete pad so that all sections are properly aligned.
- B. Switchboards shall be bolted to angle iron sills. The sills shall be imbedded in the concrete on the two longest sides. The sills shall be the full length of the equipment and shall be installed level in all directions.

3.02 TESTS AND CHECKS

- A. Inspect completed installation for physical damage, proper alignment, anchorage, and grounding.
- B. Measure, using a Megger, the insulation resistance of each bus section phase-to-phase and phase-to-ground for one minute each, at minimum test voltage of 1000 VDC; minimum acceptable value for insulation resistance is 1 megohms. NOTE: Refer to manufacturer's literature for specific testing procedures.
- C. Check tightness of accessible bolted bus joints using calibrated torque wrench per manufacturer's recommended torque values.
- D. Test ground fault systems by operating push-to-test button.

3.03 ADJUSTING AND TRAINING

- A. Provide services of factory trained technician for 8 hours to:
1. Adjust all circuit breakers, switches, access doors, operating handles, etc. for free mechanical and electrical operation as described in manufacturer's instructions.
 2. Adjust circuit breaker trip and time delay settings.
 3. Vacuum clean all interior equipment. Repaint scratched or marred exterior surfaces to match original finish.
 4. Train staff on operation and maintenance of equipment.

3.04 SPARE PARTS

- A. The following spare parts shall be furnished for each switchboard furnished:

1. Three standard packages of control power fuses of each size furnished.
 2. Three power fuses of each size furnished.
 3. Three indicating lights.
- B. All items shall be packaged in suitable containers and clearly identified as to contents.

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 Specifications.

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. 208 Volt, three phase, 4 wire panelboards shall be type NF Series as manufactured by the Square D, equal by General Electric, or Siemens.
2. 480 Volt, three phase, 3 or 4 wire distribution panelboards shall be type I-Line Series as manufactured by the Square D, equal by General Electric, or Siemens.

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.

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.

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.
- B. 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.
- C. 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.
- D. Heat dissipation from VFD enclosures shall meet all requirements of the specifications.
- E. All VFDs shall be low harmonic drives for the wastewater and water industry meeting the requirements of IEEE-519 as manufactured by Allen & Bradley, Schneider, or ABB.
- F. 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 Darlington 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 dc 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.
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 VFD enclosure mounted 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.
- m. 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.
- n. The VFD drive shall have a RJ45 Ethernet port to allow for complete data exchange of all VFD parameters over an Ethernet/IP network.

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.

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 (1) complete spare Pump VFD with enclosure identical to the VFDs being provided for the pumps.
- B. One (1) indication light of each color being utilized
- C. Three (3) fuses of each size being utilized.

3.08 WARRANTY

- A. A manufacturer's warranty for three years shall be provided for each VFD.

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

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, black thermoplastic while 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 AND COLORS

- A. For interior work devices shall be white and device plates for shall be of the required number of gangs for the application involved and shall be Type 302 (18-8) high nickel stainless steel of the same manufacturer as the device.
- B. For exterior work devices shall be black.

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.

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. When “mount up” is indicated, fixture is to be mounted the stated distance off the finished floor.

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 16612

ENGINE GENERATOR

PART 1 – GENERAL

1.01 DESCRIPTION

- A. The work of this section includes all labor, materials, tools, equipment and incidentals necessary to furnish and install, put in operation and field test quantity a diesel engine driven generator unit with sound attenuated weatherproof enclosure and doubled wall base tank of the size and rating as specified herein and on the Drawings.
- B. Provide loose shipped power cables as specified herein.

1.02 SUBMITTALS

- A. Shop Drawings and/or brochures shall be submitted to the Engineer in accordance with Section 01300.
- B. Submit all pertinent technical data including but not limited, to the following:
 - 1. Manufacturer and model of engine and generator
 - 2. Rated capacity B.H.P.
 - 3. Generator
 - 4. Generator KVA, KW and P.F. rating
 - 5. Voltage
 - 6. Class insulation
 - 7. Temperature rise above 40 degree C ambient
 - 8. Generator efficiency and fuel consumption at full load, 3/4 load and 1/2 load
 - 9. Operating weight of complete unit
 - 10. Exhaust piping
 - 11. Double walled base tank
 - 12. Battery and charger
 - 13. Auxiliary system power requirements and wiring diagrams
 - 14. Enclosure with all conduit openings for system operation identified.

- C. Manufacturer's certified test record. The test record shall show the generator performance and frequency regulation to satisfy the requirements specified herein, and shall also show fuel consumption rates at 1/2 load, 3/4 load and full rated load.
- D. Submit all other data specified in this section and as outlined in Section 01300.

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 engine generator unit shall comply with the requirements of the Federal Environmental Protection Agency and State of Massachusetts Department of Environmental Protection.
- B. The engine generator unit shall be arranged for automatic starting and stopping on failure of, and restoration of the normal source of power, and for automatic load transfer, but not including the automatic load transfer switch which will be furnished separately.
- C. The engine generator unit shall include, but not be limited to excitation system, controls, keep warm system, cooling system, silencer, starting batteries, charger, and all essential and desirable appurtenances whether specifically mentioned in this specification or not.
- D. The system described herein, including but not necessarily limited to the engine generator set, engine auxiliaries, batteries and engine generator control panels shall be furnished by a single supplier who is regularly engaged in the production of diesel fueled engine driven generators.
- E. The voltage regulation shall be within plus or minus two percent from no load to full rated load. On application or removal of full rated load in one step, the transient voltage dip or overshoot shall not exceed twenty percent of rated voltage. Frequency regulation shall be within 3 Hertz from no load to full load.
- F. The voltage regulator shall be insensitive to severe load induced waveshape distortion from SCR or thyristor circuits such as those used in battery charging (UPS) and motor speed control equipment. This SCR immune regulator shall not reduce the motor starting capabilities as specified herein.
- G. Engine generator units of not less than KW rating indicated on the contract drawings, 0.8 power factor capacity with 3 phase, 60 Hertz, 480/277 Volts, 4 wire alternating current generator shall be furnished.
- H. The engine generator units shall be completely prewired and piped so that only field connections to a master terminal strip for control, auxiliaries and alarms, and power connections to a molded case line circuit breaker and fuel fill and vent line connections will be required.

- I. The engine generator unit and associated auxiliaries systems and components shall be skid mounted and installed outdoors.

1.05 QUALIFICATIONS

- A. The generator units shall be the standard product, as modified by these Specifications, of one of the following manufacturer listed below. Engine generator unit shall be a standard production model of proven ability and shall be designed, constructed, and installed in accordance with the best practice and methods. In addition, the manufacturer shall maintain a permanent service organization and supply of spare parts as necessary to provide adequate service within 60 miles of the site. The design basis for the generator size including the enclosure and base tank are based on a Kohler unit with dimensions of 28' Length, 6.5' Width, 11.5' Height. Due to constraints on the site, units by the other manufactures must not exceed these dimension of by more than 10% which may require custom fabricated enclosures by the manufacture.
 1. Caterpillar
 2. Cummins
 3. Kohler
- B. The engine generators shall be a factory assembled unit specifically designed and fitted for operation on diesel fuel. The engine generator unit shall be free from injurious torsional or other vibration, and shall be assembled on an adequate steel subbase suitable for mounting on vibration isolation pads, on a flat concrete surface which is suitable for supporting the weight of the unit. The vibration installation material shall be furnished with the engine generator unit.
- C. The engine generator unit will be installed in Taunton, MA and rated for use at this location's elevation level. Outdoor enclosed units shall be provided with heating and cooling as required to maintain the generator set operational within the temperature limits of all devices and equipment. The engine generator unit shall be suitable for continuous operation at any temperature between 0 and 110 degree F at its full load rating and at 80 percent power factor.
- D. The engine generator unit shall be designed and built in accordance with the latest standards of IEEE, NEMA, ANSI and ASME.
- E. The engine generator unit shall be designed to minimize the danger of accidents to operating and maintenance personnel. The manufacturer shall, prior to shipment, verify that all electrical connections are tight and that circuits are isolated, that on-set piping connections are well-made, and that standard safety equipment is included and functions according to design.

1.06 ENGINE GENERATOR UNIT PERFORMANCE

- A. The engine generator unit shall maintain rated frequency from no load to full rated load.
- B. The voltage regulation shall be as specified herein and recovery to steady state operation shall be within two seconds.

- C. Stable or steady state operation is defined as operation with terminal voltage remaining constant within plus or minus one percent of rated voltage. A rheostat shall provide a minimum of plus or minus five percent voltage adjustment from rated voltage.
- D. Frequency regulation shall be maintained within 2½ percent of rated frequency from no load to full load. The steady state frequency shall be within 0.5 percent of rated frequency.
- E. The engine shall be equipped with a electronic isochronous governor capable of maintaining the engine speed from no load to full load within plus or minus .25 percent of the synchronous speed.

1.07 PRODUCT HANDLING

- A. All materials shall be shipped, stored, handled and installed in such a manner as not to degrade quality, serviceability, or appearance.
- B. Protect material and equipment, in accordance with the manufacturers recommended storage procedures, before, during, and after installation. Stored items shall be protected from the weather and contamination. During installation, piping and similar openings shall be capped to keep out dirt and other foreign matter.

1.08 WARRANTY/SERVICE

- A. The manufacturer's and dealers Extended Service Coverage shall in no event be for a period of less than five (5) years from date of Owner/Engineer's acceptance of the system and shall include repair parts, labor, travel expense necessary for repairs at the jobsite, and expendables (lubricating oil, filters, antifreeze, and other service items made unusable by the defect) used during the course of maintenance and repair. Applicable deductible costs applying only after the first year shall be specified in the manufacturer's warranty and not exceed \$500 per site visit. Submittals received without written warranties as specified will be rejected in their entirety. Warranty and maintenance shall be issued and executed by the dealer and may not be subcontracted.
- B. The generator set supplier shall have factory trained service representatives and tooling necessary to install, test maintain, and repair all provided equipment and shall be located within 150 miles of the customer's site.

PART 2 – PRODUCTS

2.01 ENGINE:

- A. The engine shall be diesel fueled, four (4) cycle, water-cooled, while operating with nominal speed not exceeding 1800 RPM. The engine shall meet applicable EPA non-road mobile regulations and/or the EPA NSPS rule for stationary reciprocating compression ignition engines. Additionally, the engine shall comply with the State and Federal emission regulations at the time of installation/commissioning. Actual engine

emissions values must be in compliance with applicable EPA emissions standards per ISO 8178 Emissions Cycle at specified ekW/bHP rating.

- B. The engine shall be furnished with thermostatically controlled jacket water heaters of the size recommended by the supplier. Heaters shall be rated for operation on 120 Volts.
- C. The oil sump will be fitted with pipe nipples, a ball valve, and an extension oil drain.
- D. The engine shall be provided with a governor which maintains the frequency within a bandwidth of the rated frequency, over a steady-state load range of zero to 100% of rated output capacity. The governor shall be configured for safe manual adjustment of the speed/frequency during operation of the engine-generator set, without special tools, from 90 to 110% of the rated speed/frequency, over a steady state load range of 0 to 110% or rated capacity.
 - 1. Steady state speed band, +/- 0.25% of rated speed.
 - 2. Internal oil pump, relief valve and accumulator controls governor operating pressure.
 - 3. Manual speed adjustment knob at top of unit.
 - 4. Positive locking to allow manual speed adjustment.

2.02 COOLING SYSTEM

- A. The engine shall be furnished with a unit mounted radiator. The radiator shall be of sufficient size to cool the water when ambient temperature is 100 degrees F. and the engine generator unit is operating at full rated load continuously.
- B. Cooling system shall further include water cooled manifolds, pusher fans and high temperature cutout. Provide radiator duct connector complete with suitable gasket, bolts and nuts. The cooling system shall be furnished with sufficient antifreeze solution to protect the cooling system with ambient air temperature down to minus fifty degrees F.
- C. Provide an anti-freeze treatment as recommended by the manufacturer for protection against corrosion and scale formation. The anti-freeze treatment shall be compatible with the antifreeze solution. The anti-freeze will be long life environmentally friendly polypropylene glycol. The concentration will be as recommended by the manufacturer.

2.03 FUEL SYSTEM

- A. The engine shall be furnished with filter, fuel pressure gage and engine priming pump.
- B. The engine-generator unit shall be furnished with an approximate 36 inch high, double-walled fuel base-tank with leak detection and fuel capacity for 48 hours of generator operation at full load. Tank shall be constructed of heavy gauge steel; epoxy coated interior, and rust proofed and finish painted exterior.

1. Tank shall conform to NFPA 30 and NFPA 47.
2. The diesel fuel oil tank shall have tappings for fuel supply and return. It shall be equipped with a suitable vent cap. The fill pipe shall be extended to the exterior wall and easily accessible and lockable.
3. The tank shall be dual wall constructed of steel and mounted directly to the generator set skid, and shall be provided with low fuel and leak detection alarms and dry contacts. For added protection the rupture basin portion of the tank shall have a leak monitoring system utilizing a non-toxic, non-volatile liquid to determine integrity of external rupture basin wall. This shall be coordinated to operate with floats and sensors of the fuel tank.
4. An 8 gallon overflow tank shall be furnished at the generator fill. The generator shall be furnished with a 2 inch diesel vent fuel line. The diesel fuel tank shall be furnished with audible and visual alarms at the fill gauge.
5. Vent and overflow piping to be provided.
6. Fuel gauge.
7. Provide tank openings to allow manual level measurement with stick gauges.

2.04 EXHAUST SILENCER

- A. The engine generator unit shall be provided with a critical type silencer including flexible exhaust fittings. Silencers shall be mounted so that its weight is not supported by the engine. Exhaust piping shall be sized as recommended by the manufacturer. Connection between engine and silencer shall be of the stainless steel flexible type.
- B. Silencers shall be Maxim MT41 equal by Kitell, or equal for turbocharged engines.
- C. A flexible section shall be provided at each engine and an expansion joint at each muffler. Flexible sections and expansion joints shall have flanged connections. Flexible sections shall be made of convoluted seamless tube without joints or packing. Expansion joints shall be the bellows type. Expansion and flexible elements shall be stainless steel suitable for diesel-engine exhaust gas at the maximum exhaust temperature that is specified by the engine manufacturer. Expansion and flexible elements shall be capable of absorbing vibration from the engine and compensation for thermal expansion and contraction.
- D. Horizontal sections of exhaust piping shall be sloped downward away from the engine to a drip leg for collection of condensate with drain valve and cap. Changes in direction shall be long radius. Exhaust piping, mufflers and silencers installed shall be insulated with 3 inches of calcium silicate insulation and covered with aluminum flashing to protect personnel.
- E. All portions of the exhaust system shall be insulated and covered with flashing.

2.05 STARTING SYSTEM

- A. The electric starting system shall consist of the following equipment:
1. The engine shall have a two wire, direct current starter suitable for automatic starting through the load transfer switch.
 2. Batteries shall be of the lead-acid type. Batteries shall be guaranteed to have sufficient capacity when in a fully charged state to perform not less than five, 15 second cranks while in an ambient temperature of 0 degrees F without recharging.
 3. Current limiting type automatic battery charger conforming to UL 1236 shall be of the static type, magnetic amplifier control with D.C. voltmeter, D.C. ammeter and potentiometer for voltage adjustment. Charger to be completely automatic, charging rate to be determined by the state of the battery, and reducing to milliamp current on a fully charged battery. Charger shall be for 120 Volt, single phase, 60 Hertz A.C. input with an output of not less than 10 amperes. The charger shall be for the correct voltage for the battery, and specifically for charging a lead-acid battery and for panel mounting. The charger shall be furnished with a battery under-voltage alarm system consisting of dry contacts for remote use.

2.06 ALTERNATOR

- A. The alternator shall be single bearing, open, dripproof revolving field, four pole brushless type, permanently aligned to the engine by flexible disc coupling. Each unit shall be reconnectable type having nine leads and shall be factory connected for three phase, 4 wire, 60 Hertz. The rating of the unit shall be as indicated on the drawings.
- B. Alternators shall have Class F insulation and shall be furnished with Amortisseur windings. Alternators shall have a complete static automatic voltage regulator which will hold the voltage within plus or minus two percent from no load to full rated load. On application of rated load in one step, the transient voltage dip shall not exceed twenty percent. The generator windings shall be braced to withstand any possible short circuit stresses. Alternator shall be "Radio Interference Proof" (RIP) and "Telephone Influence Factor" (TIF) and shall be within the limits of Section 9, ANSI C50.12. Alternators shall have a rotating brushless exciter and rectifier.
- C. The alternator characteristics shall be matched to the torque characteristics of the engine in such a manner that with full load connected to the alternator terminals, the alternator will utilize all the available engine power without exceeding it at all speeds.
- D. The generator exciter shall be of the brushless type. Semiconductor rectifiers shall have a minimum safety factor of 300% for peak inverse voltage and forward current ratings for all operating conditions, including 110% generator output at 40 degrees C 104 degrees F ambient. The exciter and regulator in combination shall maintain generator-output voltage within the limits specified.

- E. Each generator shall be provided with a solid-state voltage regulator, separate from the exciter. The regulator shall maintain the voltage within a bandwidth of the rated voltage, over a steady-state load range of zero to 100% of rated output capacity. Regulator shall be configured for safe manual adjustment of the engine-generator voltage output without special tools, during operation, from 90 to 110% of the rated voltage over the steady state load range of 0 to 100% of rated output capacity. Regulation drift shall not exceed plus or minus 0.5% for an ambient temperature change of 20 degrees C. 68 degrees F.
- F. Alternators shall be furnished with 120V stator heater and controls.

2.07 CONTROLS

- A. The engine generator unit shall be furnished with a shock resistant, engine mounted microprocessor control panel with LCD display mounted in a NEMA 1 enclosure, dead front, with removable top panel.
- B. The control panel shall have Modbus communication over Ethernet connection for remote system data monitoring by third party systems.
- C. The following standard data shall be indicated from the LCD display and be available via the Modbus communications connection:
 - 1. Jacket water temperature
 - 2. Lube oil temperature
 - 3. Lube oil pressure
 - 4. Battery voltage
 - 5. RPM
 - 6. A.C. Voltmeter
 - 7. A.C. Ammeter
 - 8. Frequency meter
 - 9. Elapsed time meter calibrated in hours and tenths of hours
- D. Accessories shall include:
 - 1. Current transformers.
 - 2. Fuses
 - 3. Generator voltage regulator
 - 4. Voltage adjusting rheostat.

5. Fault indication lights one each for:
 - a. low oil pressure
 - b. high water temperature
 - c. overspeed
 - d. overcrank (fail to start).
 6. Prewarn indication lights one each for:
 - a. low oil pressure
 - b. high water temperature.
 7. 90 DB (a) Audible alarm to sound on any fault or prewarn and an alarm silencer.
 8. Mode selector switch – "AUTO", "OFF", "MANUAL" with audible alarm when switch is not in "AUTO" position.
 9. Control power fuse.
 10. Fixed overcrank timer - four-10 second cranks shall be provided. After four cranks, the unit shall stop and an alarm initiated.
 11. Auxiliary contacts which close when engine is in operation. Contacts shall be rated 10 amperes and shall be used to interlock combustion and ventilation air dampers.
 12. Common failure relay
 13. Dry contact kit with the minimum following contact signals:
 - a. Engine Running
 - b. Engine Trouble
 - c. Battery Charger Alarm
 14. Engine sensors for low water temperature near low oil pressure, near high water temperature.
- E. In addition to the equipment included in the control panel described above, the unit shall include a power and control junction box mounted on the generator. This junction box shall include:
1. Three phase power conductors terminated with pressure type ring connectors.
 2. Neutral connection.
 3. Terminal block with marked connection points for all external control connections and for jacket heaters, etc.
 4. Molded case line circuit breaker with interrupting rating of 42 KA amperes RMS.

- F. Automatic shutdown shall be provided for each of the following conditions:
 - 1. High jacket water temperature
 - 2. Low jacket water pressure
 - 3. Low lubricating oil pressure
 - 4. Engine overspeed
 - 5. Unit fail to start.
- G. Auxiliary normal open dry contacts shall be provided for remote transmission of unit failure.

2.08 SUB-BASE

- A. The engine, generator and radiator shall be mounted on a structural steel base designed to maintain proper alignment. Vibration isolators shall be furnished of the size and type recommended by the supplier.

2.09 ENCLOSURE

- A. A sound-attenuated weather-protective housing shall be furnished. The housing shall enclose the complete unit and all related equipment (e.g. battery, battery charger, engine controls and control panel, etc). All components shall be wired and piped within the enclosure.
- B. The housing shall be constructed of 14 gauge rolled steel and shall include hinged locking access doors. Housing surfaces shall be prime painted with two coats of a rust resistant primer and finished with a dark green enamel paint.
- C. The housing shall be sound insulated, vandal proof, and padlocked. The resulting structure with engine-generator in operation shall not transmit more than 75 db at a distance of 23 feet from the generator in any direction. There shall be no Puretone. The generator set manufacturer shall choose the thickness of insulation to meet the aforementioned sound criteria.
- D. The housing shall be furnished with weather-protective fixed louvers, and weather-protective flanged door openings to insure weather-resistant construction.
- E. Stainless steel flexible exhaust sections shall be provided. Exhaust outlet shall be terminated with a "shanty cap" designed so to prevent entrance of rain into exhaust outlet. All handles, sheet metal screws, bolts, nuts, hinges, and other exterior hardware shall be stainless steel.

- F. Provide factory wired intrusion detection style doors switches for each of the enclosure entry doors that shall be wired in series to one another and terminated at a junction box within the generator enclosure.

2.10 POWER CABLES

- A. Provide colored power cables for each of the 3 phases, neutral, and ground connections with pre-wired NEMA 4X male camlock connector and female Cam Lock connectors.
 - 1. Cable to be UL type W portable power cable with copper conductors insulated with synthetic rubber (EPDM). The cable is to be covered with a colored CPE rubber jacket applied in two layers with reinforcement placed between the layers.
 - 2. Cable and plug assembly to have rated capacity of 400 Amps with following color coding.
 - a. Phase A - Brown
 - b. Phase B – Orange
 - c. Phase C – Orange
 - d. Neutral – White
 - e. Ground – Green
- B. All cables shall have a minimum length of 50 feet.

PART 3 – EXECUTION

3.01 MANUFACTURER'S SERVICES

- A. A minimum of one, eight-hour day shall be provided to supervise the installation and testing of the equipment furnished, to assist in start-up and train Owners maintenance personnel.
- B. A minimum of one, four hour day, not including travel time to and from the site, shall be used by a fully qualified field service engineer to make necessary adjustments and to provide operator training on the equipment furnished. This work shall occur after the equipment has been in operation and at the request of the owner, but not to exceed one year after the acceptance of the facility.

3.02 TESTS

- A. At least 48 hours prior to the load test, the manufacturer shall perform a pretest. The pretest shall be conducted in the presence of the Engineer. The pretest shall determine that the unit is ready for load testing and that all components are functioning correctly. All adjustment for tuning the unit shall be made during the pretest. If remedial work is required, the work shall be performed before the load test is conducted.
- B. Upon completion of the installation, the manufacturer of the equipment shall test the complete unit, at full load, using load banks, for four continuous hours. During the test, the following data shall be taken at 15 minute intervals:

1. Outside air temperature
 2. Generator room temperature
 3. Oil pressure
 4. Oil temperature
 5. Jacket water temperature
 6. Battery charge rate
 7. Fuel pressure
 8. A.C. Volts
 9. A.C. Amps
 10. Frequency
 11. Kilowatts.
- C. Following the test, three successive simulated power outages shall be conducted using all connected building load.
- D. The equipment shall be left in good operating order and the settings of all alarm and shutdown devices verified.
- E. The diesel fuel required for testing shall be supplied by the electrical contractor, upon engineer acceptance of the tests results the electrical contractor shall fill the generator's base tank and make the unit completely ready for full operation.

3.03 OPERATION AND MAINTENANCE MANUALS

- A. Furnish Operation and Maintenance Manuals as specified in Section 01730.
- B. Maintenance instructions shall be furnished for batteries, to include simple and clear procedures for addition of liquids, maintaining cleanliness, proper ventilation, proper electrical connections.
- C. Maintenance instruction shall be furnished for engines, including recommended lubricants, coolants, etc., recommended maintenance intervals, and recommended ventilation requirements.
- D. The Operating manual shall be a simple starting and stopping procedure, with reference to shop drawings information for more complicated procedures.

END OF SECTION

SECTION 16720

SECURITY SYSTEMS

PART 1 – GENERAL

1.01 DESCRIPTION

- A. The Work of this Section includes the furnishing and installing of complete security systems consisting of CCTV System, Access Control System, and Security Devices as specified in the Contract Documents.
- B. CCTV System
 - 1. The system shall consist of cameras, manufacture required accessories, and interconnecting cabling and raceway. Cameras shall be networked into the City of Framingham’s existing CCTV servers.
 - 2. Provide complete camera and server programming and configuration. Meet with the owner prior to configuration and programming to determine any specific criteria.
- C. Access Control System
 - 1. The system shall include door control panel, card readers, magnetic door switches, and interconnecting cabling and raceway.
 - 2. Provide complete database programming including data entry for each facility member. Meet with the owner prior to database programming to determine complete member list, access levels, standard entry times, standard exit times and day of week configurations and any other Owner criteria.
- D. Security Devices
 - 1. The system shall include door switches, heat detectors, help call pushbuttons, and interconnecting cabling and raceway for connection into the Station’s SCADA control panel.
- E. Provide all required coordination with door installations for proper installation of devices and wiring.
- F. Provide all licensing.

1.02 SUBMITTALS

- A. Manufacturer's literature and brochures shall be submitted for all items to be furnished in accordance with the provisions of the SECTION 01300, SUBMITTALS.

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

1. Cameras and mounting equipment
2. Door Control Panel.
3. Card Readers.
4. Magnetic Door Switches
5. Heat Detectors
6. Help Call Stations
7. Complete system wiring diagrams and elementary or control schematic for each system.
8. Data sheets and outline drawings showing details for mounting all control devices and panel.
9. Standard preprinted sheets or drawings simply marked to indicate applicability to this contract will not be acceptable.

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 security systems shall be provided and installed by the City of Framingham's existing security integrator vender Convergent, other security integrator vendors are not allowed as the City has standardized on Convergent.
- B. CCTV System
 1. Cameras shall be completely accessible to view, configure and control over a SQL server internet connection.
 2. The CCTV system components shall be the standard product by Axis, as modified by these specifications of a manufacturer regularly engaged in the production of this type equipment. The City of Framingham has standardized on Axis, no equal allowed.
- C. Access Control System
 1. The system design and installation shall conform to UL-294.

2. The Access Control System components shall be the standard product, as modified by these specifications of a manufacturer regularly engaged in the production of this type equipment.
3. System Operation
 - a. Each door as indicated on the drawings shall be furnished with an proximity card reader that when present with a identification card will transmit the card information to the door controller that shall search the system database and if verified for access release the electric door lock for that associated door.
 - b. An access code shall be prevented from being used twice at the same door within a user-defined amount of time.
 - c. After a release has been executed on a door lock the controller shall monitor the door contact status and upon an open and then close sequence lock the associated door. A maximum time delay of 10 seconds shall allow for the open/close sequence that when expired, the controller shall lock the associated door.
4. The Access Control System shall be S2 as manufactured by Lenel, the city has standardized on this system and no equal allowed.

PART 2 – PRODUCTS

2.01 CAMERAS

- A. IP, box housing, Pant/Tilt/Zoom, High Definition Color type UL listed network camera with technology for low light condition adjustments, Infrared Illuminators, and day/night modes of operation.
- B. High Definition: H.264 streaming capability at more than 30/25 fps.
- C. Resolution: 1920 x 1080.
- D. Viewing Angle: 360 Degrees.
- E. Lens: 2.8mm – 13mm, Motorized, F1.4
- F. Frame Rate: 30 fps
- G. Minimum Illumination: Color - 0.15lux, B/W – 0.03lux
- H. IR Illuminators: Manual/SmartIR/Off light color.
- I. Ingress Protection: IP66 Rated

- J. Vandal Resistant: IK10 Rated
- K. Network Interface: 8-pin RJ-45 connector, 10Base-T/100Base-TX Ethernet
- L. Power Requirements: PoE (Power over Ethernet) Class 0, 6.5W Max.
- M. Mounting: Parapet mounting bracket, provide mounting bracket and box.
- O. Temperature Range: -13 F – 122 F
- P. Camera shall have digital Pan/Tilt/Zoom remotely controlled.
- Q. Camera shall have tampering detection function that alerts operators if camera lens is covered or position is altered.
- R. Camera shall have built in motion detection filtering capability that can discriminate between environmental background motion noise and actual motion.

2.02 Door Control Panel

- A. Control panel shall contain a microprocessor based controller that provides local entry-control functions for a minimum two doors including one and two-way communications with card readers, request to exit, remote door release, door strikes, and control inputs. The controller shall operate as a stand-alone portal using the downloaded database from the system's existing server.
- B. The control panel enclosure shall be sheet metal steel with a hinged lockable door and pre-punched conduit access knockouts.
- C. Primary input power shall be 120 volt AC and then rectified to a 24VDC for system operation. Backup power to the primary power shall be by dedicated batteries in the Control Panel. Batteries shall also be rechargeable type capable of continuous operation for a minimum 4 hours without recharge or replacement.
- D. The controller shall supply and control 1 amp at 24VDC of power for each door electric strike.
- E. The controller shall allow a for the following control and monitoring inputs:
 - 1. Door Switch (per door)
 - 2. Reader Tamper Monitoring (per door)
 - 3. Request to Exit (per door)
 - 4. Remote Door Release (per door)
 - 5. Remote Door Lock (per door)

6. Access Allowed (per door)

- F. The door controller shall have an Ethernet port for direct communications with the existing system's server.

2.03 Proximity Card Readers

- A. Detection proximity card readers shall provide power to compatible credential cards through magnetic induction, and shall receive and decode a unique identification code number transmitted from the credential card then communicate the information to the access controller. The cards shall have a led indication light and tamper indication.
- B. The card reader shall receive power from the access control panel.
- C. The card reader shall read proximity cards in a range from contact with to at least 6 inches from the reader.
- D. Readers shall have reader supervision and supply a tamper output to the controller.
- E. Card readers located on the building exterior shall be UL listed for wet locations.

2.04 MAGNETIC SWITCHES

- A. Dual contact recessed mounted magnetic door switches consisting of a contact housing element and magnet housing elements.
- B. The switch mechanism shall have a gap distance range up to 3/8-inch.
- C. The contact element shall contain a hermetically sealed magnetic reed switch and shall be potted in the contact housing with a polyurethane base compound.
- D. The magnetic element shall contain a rare earth magnet made of neodymium iron borton.
- E. The recessed mount housing for the switch elements shall have rugged uni-body construction made of flame retardant ABS plastic that that allows the housing to be snapped locked in a 3/4" to 1" hole.
- F. The contact element shall have 12" cord lead and shall terminate in a junction box or other electrical enclosure.
- F. Provide explosion proof rated limit switches for the wet well door hatches.

2.05 HEAT DETECTORS

- A. Fixed temperature 135 degrees F, rate of rise, vapor-tight industrial grade units.

2.06 HELP CALL PUSHBUTTONS

- A. The pushbuttons shall be red, twist to release keyed pushbutton with a minimum (1) NO and (1) NC contact and mounted on a curved stainless steel plate factory engraved with "Help Call". The pushbutton shall surface mounted on a standard device box.
- B. Provide clear polycarbonate resin thermal covers over all Help Call pushbutton stations.

PART 3 – EXECUTION

3.01 INSTALLATION:

- A. All wiring shall be color coded.
- B. Coordinate the installation of the door switches and wiring with the doors.
- C. Ground system components and conductor and cable shields to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other impairments.

3.02 FINAL TESTS / WARRANTY

- A. Final testing and adjusting of the system shall be by the system supplier. Provide factory trained technicians to demonstrate the system to the satisfaction of the Owner's Representative and make all additional adjustments to the system operation as required by the Owner's Representative.
- B. A copy of the final test report 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 ADJUSTING

- A. Occupancy Adjustment. When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting and reprogramming to suit actual occupied conditions. Provide up to two visits for this purpose without additional cost.

3.04 DEMONSTRATION

- A. Engage a factory-authorized service representative to explain programming and operation of system and to train Owner's maintenance personnel on procedures and schedules for maintaining, programming, operating, adjusting, troubleshooting, and servicing system. Provide a minimum of four hours' training in operation and maintenance.

3.05 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 on the operation of the system.

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 16740
COMMUNICATION SYSTEM

PART 1 – GENERAL

1.01 SCOPE

- A. The Work of this Section includes the furnishing and installing of complete communication system as specified in the Contract Documents.
- B. The system shall include, but not be limited to plywood backboards, conduit, CAT 6E cable, fiber optic cable, back boxes, jacks, wall plates, fittings, terminations, equipment rack, patch panels, punch down panels, Ethernet switches, power supplies, and all other appurtenances leaving the entire installation complete.
- C. Install a complete raceway conduit system including mounting back boxes and junction boxes from each outlet, WAP location, CCTV camera, and control panel to the equipment rack location. Install CAT6E cables for each tel/data jack module and CCTV Camera from device back to equipment rack in tel/data room.
- D. Terminate all CAT6E cable at patch panel (Data, Camera, and control panels) and punch down panels (Telephone) mounted in equipment rack.
- E. Provide all required coordination with utility service provider RCN and owner.

1.02 MEASUREMENT AND PAYMENT

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

1.03 SUBMITTALS

- A. Manufacturer's literature and brochures shall be submitted for all items to be furnished in accordance with the provisions of the SECTION 00700, GENERAL CONDITIONS.
- B. Submittals required under this section include, but are not limited to the following:
 - 1. CAT6E Cable and Jacks
 - 2. Fiber Optic Cable
 - 3. Equipment Rack
 - 4. Patch Panels
 - 5. Punch Down Panel
 - 6. PoE Ethernet Switch

7. Uninterrupted power supply (UPS).

8. Patch Cords

1.05 PRODUCT HANDLING

A. 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 AND BACK BOXES

A. Conduit and back boxes shall be as specified under SECTION 16130, RACEWAYS AND FITTINGS.

2.02 CAT6E CABLE AND JACKS

A. CAT6E cable shall be UL listed, NEC CL2, CAT 6E type with 4 pair copper, UTP, 23 Awg conductors.

B. CAT6E cables to be labeled and tested for continuity by contractor per manufacturer's specifications.

C. Jacks and Jack Assemblies shall be Modular, color-coded, eight-position modular receptacle units with integral IDC-type terminals. Provide device wall plates for each jack, wall plates shall be as specified under SECTION 16500, LIGHTING SYSTEMS.

2.03 FIBER OPTIC RISER CABLE

A. Single Mode OS2 Type - Outdoor Stranded Loose Tube, Gel Free, 12-Strand, all Dielectric with HDPE jacket.

B. Provide termination connectors on all strands on both ends.

2.04 EQUIPMENT RACK

A. Provide a Steel equipment rack enclosure with uniform, baked-enamel factory finish over rust-inhibiting primer.

B. Rack shall be wall Mounted, 36 inches high, 22" inches wide (19" wide equipment mounting), 18 inches deep with rear hinged swing section and plexiglas front door.

C. Rack to have universal hole pattern on front and rear flanges, and mounting 10-32 threaded mounting holes on both sides of rack assembly

D. Rack to have grounding bus bar and is to be grounded building grounding system.

- E. Rack to have top mounted plug in type ventilation fan.
- F. Provide with full vertical mounted power distribution strip consisting of grounded receptacles a master power on/off switch, pilot light and surge protection.

2.04 PATCH PANEL

- A. Provide a 19” wide rack mounted high density patch panel with a minimum 48 port with integral cable management panel located below the patch panel.
- B. Wiring shall conform with T568B wiring.

2.05 PATCH PANEL – FIBER OPTIC CABLE

- A. Provide 19” wide rack mounted light guide interface unit (LIU) patch panels with a minimum 12 ports, and SC connectors.

2.06 PUNCH DOWN PANEL

- A. Provide a 19” wide 110 rack mounted punch down panel with minimum 50 pair blocks and integral cable management panel located below the punch down panel.

2.07 POE ETHERNET SWITCHES

- A. Provide a PoE Ethernet switch and mount in the equipment rack.
- B. The Ethernet switch shall have 24 auto sensing 10/100/1000BASE-T PoE ports and two GbE fiber ports. All ports shall support auto negotiation or manual configuration for 10/100/1000 MHz or full/half duplex.
- C. The Ethernet switch shall be IEEE 802.1 and IEEE 802.3 compliant. The switch shall support 10/100/1000BASE-T and 1000BASE-SX standards. The switch shall support IEEE 802.3x flow control. Port setting controls shall include enable/disable and speed selection. The switch shall use store-and-forward switching mode.
- D. The Ethernet switch shall have an LED power indicator and shall operate from a 120VAC power source. The switch MSR LED, PoE LED, and port link status LED The switches shall be suitable for operating from -25°C to 65°C fan less and from 5 percent to 95 percent non-condensing relative humidity. The switch shall be UL approved.
- E. Ports to support both 15.4 W and 30W high power with a minimum total PoE power budget of 195W.
- F. The Ethernet switch shall support a tree or ring network topology. The switch shall support SNMPv3 and IP addressing via BootP/DHCP. The port configurations shall be accessible through a standard Web browser.
- H. The Ethernet switch security features shall include capability to disable ports and password security for configuration. The switch shall support multicast messaging via

IGMP protocol and shall utilize IGMP snooping. The switch shall support port based virtual LAN (VLAN) configuration. The switch shall support the IEEE 802.1p standard for QoS traffic prioritization. The switch shall come supplied with configuration and management software for installation on a Windows-based PC. The switch shall come supplied with all necessary cables to connect the switch to a Windows-based PC for configuration.

- I. Ethernet Switch shall be Catalyst 9200 series manufactured by Cisco, no equal to match owners standard.

2.08 UNINTERRUPTABLE POWER SUPPLIES (UPS)

- A. For each equipment rack provide a 2200VA 19” wide rack mounted UPS with LCD display and LED status indicators for battery status.
- B. Input Power: 120VAC, single phase via 8 foot cord with a NEMA 5-20P plug.
- C. Output Power: 120VAC, single phase via (6) NEMA 5-15R and (2) NEMA 5-20R rear mounted receptacles.
- D. Interface ports: Serial (RJ45), USB, and SmartSlot.
- E. Surge Energy Rating: 480J.
- F. Filtering: Full-time multi-pole noise filtering with 0.3% IEEE surge let-through, zero clamping response time and meets UL 1449.

2.09 PATCH CORDS

- A. Provide (24) CAT 6E, 18” long patch cords ETL verified to TIA-568-B for installation for connections between the patch panels and Ethernet switch.
- B. Provide fiber optic patch cords for installation for connections between the fiber optic patch panel and Ethernet switch.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. Coordinate location of rack mounted equipment with owner prior to making any terminations.
- B. Coordinate type of jack module in each tele/data wall plate with owner prior to making any terminations.
- C. Fire stop and seal all penetrations as required to maintain fire separations.

- D. Cables shall be terminated with connecting hardware of same category or higher that shall comply with TIA/EIA-568-B.2, IDC type, with modules designed for punch-down caps or tools
- E. All cables and wall jacks 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 TESTING

- A. All cables shall be tested for continuity by contractor per manufacturer's specifications.

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

DIVISION 17

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 17300

INSTRUMENTATION AND CONTROLS

PART 1 – GENERAL

1.01 DESCRIPTION

- A. The work of this section includes furnishing all labor, materials, tools and equipment required to furnish and install a complete pump station RTU control panel, and instrumentation and implement into the existing city wide SCADA system. The system shall include instrumentation equipment, a new remote telemetry unit panel (RTU-1) and modification to the existing SCADA system located at the Framingham Department of Public Works, 100 Western Ave, Framingham, MA.
- B. The work required by this section shall include all primary instrumentation equipment and devices necessary to provide process data and monitoring as shown and as specified. The particular requirements of this section are specific in that this system supplier must furnish and install a system which will provide for an input/output SCADA interface. All input/outputs (I/O) shall be collected as noted in the I/O lists of this project. In addition, the system shall include a Modbus communication interface and connections to additional equipment being provided under other Divisions of these specifications. The loop descriptions provide a functional description for the process portion of the system.
- C. The Instrumentation and Controls System supplier shall carefully review all requirements of this section in order to fully understand the limit of responsibility and the extent of what must be done to complete this portion of the system. It shall be understood that this system supplier will provide for a complete and operational I/O system that shall be completely documented and coordinated in order to provide for a complete system interface. Data collection shall be accomplished through a data highway via PLC to PLC network, remote I/O or hard-wired inputs to the main PLC. All input/outputs (I/O) shall terminate at each of the respective panels.
- D. The capacity and quality of instruments and equipment shall be provided such that they perform the function described in the SYSTEM DESCRIPTION, as shown on the Contract Drawings and as listed in the Instrumentation List at the end of this section. It is the intent of this section of the specifications to specify a complete instrumentation and monitoring system. Anything that is not shown on the drawings but is mentioned anywhere in the specifications or vice versa, or anything not expressly set forth in either but which is reasonably implied, shall be furnished and performed as though specified, shown and mentioned in both. If an item appears in one area of the contract documents but not in another, it shall be provided in its entirety. This system supplier shall obtain and review complete set of the specifications and drawings prior to submitting final costs for the work of this section and/or any related sections.
- E. Equipment under this section shall be fabricated, assembled, installed, and placed in proper operating condition in full compliance with details, drawings, specifications, engineering data, instructions and recommendations of the equipment manufacturer as approved by the Engineer.

- F. The Instrumentation and Controls System supplier under this Section shall insure total compatibility where interfacing between equipment is required and shall initiate and maintain close communication and cooperation with the supplier of the equipment throughout the shop drawing and equipment start-up and testing phases of the work and insure total compatibility of all required interfacing at no extra cost to the Owner.
- G. An Ethernet based fiber optic network and a backup radio telemetry network shall be configured for this instrumentation system in order to link input/output data to the existing SCADA system. A PLC to PLC network shall be established. All SCADA HMI and OIT screen configurations shall be the responsibility of the owner and not this Instrumentation System Supplier.
- H. Due to the complexity of the work of this and other related sections and in order to establish a basis of bid for the equipment designed herein, a specific PLC manufacturer and control panel equipment has been indicated within on the Instrumentation and Controls Drawings. This has been done to match existing equipment at the SCADA system and other pump stations. In order to properly establish the requirements of this and other related sections, all system equipment and components for this PLC (Programmable Logic Controller) system as designed shall be as manufactured by Allen Bradley. Any deviation or substitutions at this time which requires any direct additional costs or additional work and results in additional costs for the requirements of this section shall be incurred by this Contractor and not the Owner. Also, any cabling data exchange changes, equipment changes, etc. shall be the responsibility of this system supplier to coordinate and provide as necessary to allow acceptability of the approved system. This shall be completely understood and there shall be no additional costs incurred due to failure to provide these requirements as noted.
- I. The Instrumentation and Controls system supplier shall provide and configure a new fiber optic network and radio modem network telemetry control panel that shall include, but not be limited to, PLC, instrumentation, UPS system, power distribution equipment, power supplies, Ethernet Switch, radio modems, antennas, and CAT6 interface cable. The new fiber optic network telemetry control panel shall be implemented into an existing city wide fiber optic network SCADA system.
- J. Work specifically required under this Section and Section 17320 includes all Instrumentation/Controls work shown on or required by Contract Drawings IC-1 thru IC-3, I-00x, and I-XXX thru I-XXX.
- L. The contractor undertaking the work of this section shall review the other specification sections for additional scope items that are included in or bear upon the work.

1.02 SUBMITTALS

- A. Submit the following in accordance with Section 01300 - Submittals:
 - 1. Manufacturer's data, order sheet or equivalent for each individual instrument 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.

2. Manufacturer's outline and mounting dimensions for all field mounted devices, and scaled layout drawings for primary and supplemental control panels, including interfacing details for equipment to be supplied under DIVISION 11.
 3. A letter stating the control panel shall be fabricated per drawings I-001, and I-101 thru I-107 and specification 170xxx.
 4. The system supplier shall clearly identify any exception to the specification or drawings. Failure to do this will be grounds for rejection of the submittal.
- B. For approval before release for manufacturing:
1. All equipment to be furnished under this Section must be approved prior to any of this equipment being released for manufacturing unless otherwise noted by the Engineer.
- C. Shop drawings shall be submitted in accordance with Section 01300 - Submittals 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 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.
 2. If more than two submittals (initial submittal and one re-submittal) are required for approval, the system supplier shall be liable for back charges for the Engineer's services to review additional submittals.
- D. Shop drawing review period for this section shall extend beyond the specified period as defined in Section 01300 - Submittals. Due to the complexity of the system the review period allowed shall be a minimum of forty-five (45) days unless otherwise agreed to by the Engineer.
- E. Operation and Maintenance Manuals shall be submitted in accordance with the requirements of Section 01730 - Submittals.

1.03 RESPONSIBILITY FOR EQUIPMENT

- A. The 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 the RTU control panel, instrumentation shall be by a single Instrumentation and Control System Supplier. The supplier shall be responsible to the 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 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 Contractor shall furnish record drawings for each entire system. This shall include drawings for all locations with point to point wiring for the equipment. The drawings shall be complete and shall require on site verification and acceptance by the Engineer.
- E. The Instrumentation and Control System Supplier shall be required to furnish equipment that is installed under other Sections in the Contract Documents. The 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.

1.04 DESIGN CRITERIA

- A. All instrumentation shall meet or exceed I.S.A. Standards and Recommended Practices, ANSI, National Electrical Code, OSHA, and any other applicable code or local regulation. All panel instruments shall be of the same manufacturer and model type to provide uniform appearance.

1.05 SYSTEM DESCRIPTION

- A. Each loop description contains the basic functional description of the process. All components necessary to complete these functions shall be provided to satisfy the requirements of this section.
- B. Contacts referred to in the Loop Descriptions shall be "dry" type either normally open or normally closed as required for the function described. All contacts shall be rated 10 ampere at 120 volts.
- C. The scales of instruments and devices described in the instrument loop descriptions shall be as specified and noted in the Instrument List. All indicator scales shall read out in appropriate "Engineering" units. In cases where this information is not provided this shall be clarified and coordinated with the Engineer.
- D. Loop descriptions (and associated Loop Drawings) are intended to provide a conceptual overview of required system operation. Each of the loops may or may not show all specific components necessary for each system operation. The instrumentation system supplier shall provide all necessary equipment, devices, components, signal conditioners, PLC components and other requirements for complete and satisfactory system operation. The system supplier shall provide all necessary current-to-current converters (I/I's) required by loop description to provide proper signal loading.
- E. All signal interfacing compatibility is the responsibility of the supplier of equipment

under Section 17300 (Instrumentation and Control System) and requires close coordination and cooperation with the supplier of equipment under DIVISION 11 - EQUIPMENT. In the loop description, any equipment or device which is not noted but shown elsewhere on loop drawings, specifications, etc. shall be provided by this system supplier in its entirety. Anything that is not shown on the drawings but is mentioned anywhere in the specifications or vice versa, or anything not expressly set forth in either but which is reasonably implied, shall be furnished and performed as though specified, shown and mentioned in both. If an item appears in one area of the contract documents but not in another, it shall be provided in its entirety. This system supplier shall obtain and review complete copies of both the specifications and drawings prior to submitting final costs for the work of this section and/or any related sections. Any discrepancies shall be brought to the attention of the Engineer prior to submission of the final bid price in order to clarify any and all issues.

1.05 INSTRUMENTATION AND CONTROL SYSTEM SUPPLIER

- A. The Instrumentation and Control System Supplier shall be one of the following pre-qualified Instrumentation and Control System Supplier's listed in alphabetical order.
1. Electrical Installations, Inc.
Moultonboro, New Hampshire
603-253-4525
 2. Elm Electrical
Marlborough, Massachusetts
508- 480-9300
 3. Harbor Controls
North Kingstown, RI
401-667-0930
 4. R. E. Erickson Co., Inc.
Walpole, Massachusetts
508-668-9330
- B. Only pre-qualified Instrumentation and Control System Suppliers shall be allowed.

1.06 LOOP DESCRIPTIONS

- A. LOOP 100: WET WELL LEVEL MONITORING
1. The Wet Well level shall be measured by a bubbler system level monitoring panel (LIT-100) with an air tube submersed in the wet well and level output hardwired into the RTU-1 PLC. Level shall be indicated and trended at the SCADA HMI and the OIT. The SCADA system shall record the levels (LIR-100).
 2. The bubbler system level monitor panel (LIT-100) shall provide a 4-20 mA DC output signal proportional to the wet well level to the PLC. This signal shall be the primary means for automatic pump control, refer to Loop 101. The Level

shall trigger high and low level alarms that are to be displayed at the SCADA HMI and the OIT.

3. High and Low level float switches (LSH-100A, LSH-100B, LSH-100C, LSL-100A, LSL-100B) shall be installed in the wet wells. These switches shall provide backup alarms to the level transducer as well as providing a hardwired control of the pumps in case of a PLC, UPS, or transducer failure. The float switches shall be wired through intrinsically safe relays. A contact from each intrinsically safe relay shall be wired to the RTU-1 PLC, to RTU Control Panel LED pilot lights for high and low level alarms and to back-up level control as described in Loop 101. Alarms shall be displayed at the SCADA HMI and the OIT
4. The bubbler system level monitor panel shall provide a general system alarm (YA-100) that shall be displayed at the SCADA HMI and the OIT.

B. LOOP 101: SEWAGE PUMP #1

1. The Sewage Pump #1 is controlled via a floor mounted variable frequency drive (VFD). Operation of Sewage Pump #1 shall be monitored and controlled automatically through the RTU-1 PLC via hardwired I/O. The Pump has a Hand/Off/Auto selector switch at the VFD. When in the "Auto" position the remote automatic control and remote manual control through the OIT and SCADA HMI is enabled.
2. The following control, status and alarm signals shall be wired to the PLC I/O and displayed at the OIT and SCADA HMI:
 - a. Sewage Pump #1 HOA switch in "Auto" position (YI-101A)
 - b. Sewage Pump #1 run status (YI-101B)
 - c. Sewage Pump #1 Start/Stop (YS-101)
 - d. Sewage Pump #1 VFD alarm (YA-101A)
 - e. Sewage Pump #1 VFD speed feedback (SI-101)
 - f. Sewage Pump #1 VFD speed command (SC-101)
 - g. Sewage Pump #1 by-pass status (YI-101C)
 - h. Sewage Pump #1 soft starter alarm (YA-101B)
 - i. Sewage Pump #1 high motor temperature alarm (TSH-101)
 - j. Sewage Pump #1 seal chamber leak detection alarm (MSH-101)
 - k. Sewage Pump #1 emergency stop (OS-101)
 - l. Sewage Pump #1 check valve failure (ZSA-101)

m. Sewage Pump #1 water seal failure (PSA-101)

3. Non-resettable elapsed time meter shall be displayed at the OIT and SCADA HMI (KQI-101B).
4. A pump state disparity alarm shall be displayed at the OIT and SCADA HMI if the called state of the motor and the state of the run status contact do not agree after a preset adjustable time (YA-101C). The disagreement alarm is enabled if the H/O/A switch is in the "Auto" position. The disagreement alarm must be manually reset through the OIT or SCADA HMI before Remote Automatic Control and Remote Manual Control is enabled.
5. Remote Automatic: The pumps shall be controlled by a PID loop to maintain a constant, operator adjustable wet level (LIT-100) set point. It shall be possible to select any combination of Pump #1, Pump #2, Pump #3 as Lead, Lag, and Standby through the OIT or SCADA HMI. The Lead Pump shall come on at 100% speed for 5 seconds and then drop to an operator adjustable start speed (initially set at 85%) when the level in the wet well exceeds an operator configurable level set point. If the PID loop maintains a speed command of 90% or greater for an operator adjustable time delay (initially set for 2 minutes), the Lag Pump shall start at 100% speed for 5 seconds and then both pumps shall be sent an operator adjustable speed command (initially set at 85%) and the PID control shall be restarted. If the speed command drops below an operator adjustable minimum speed command (initially set at 75%) the Lag Pump shall be shut off and the Lead Pump sent a 90% speed command before the PID control is restarted. The lead/lag pumps will continue to run in this manner until the wet well drops below an operator configured low level setpoint. The lead/lag/standby pump shall alternate every pump cycle, the standby pump shall also automatically and seamlessly take over for any of the other pump upon a pump failure.

All pumps maximum speed commands shall be limited to maintain a pump station combined effluent flow less than an operator selected maximum station effluent flow set point (initially set for XXMGD). As the station's effluent flow approaches the maximum flow set point the level PID control output speed command upper limit of 100% speed shall be reduced to maintain the effluent flow just below the maximum set point. If the wet well level continues to rise and exceeds an operator selected high-high level a high-high level alarm will be activated and displayed at the OIT and SCADA HMI.

6. Remote Manual Control: The pump is manually start/stopped (YS-101) and VFD speed command (SC-101) is manually entered via the SCADA HMI and OITs.
7. Either in Remote Automatic or Remote Manual Control any running pump shall be automatically stopped if the Wet Well #1 level or Wet Well #2 level drops below and operator configurable set points for an operator configurable time period.

8. If a pump experience a seal chamber leak alarm that pump shall be automatically designated as the standby pump.
9. If a pump is not available for service because of the following, the standby pump shall take over for the unavailable pump. The pump shall be locked out upon a disparity alarm or system protection alarm and must be manually reset before it can resume operation.
 - a. Disparity alarm (see below),
 - b. Motor over temperature alarm.
 - c. Motor chamber leak alarm.
 - d. Motor electrical chamber leak alarm.
 - e. HOA switch is not in “Auto”.
10. Back Up Level Control
 - a. Back-up hardwired pump control logic utilizing the high and low level switches in wet well shall be provided.
 - b. If the wet well level reaches the high float switch level (LSH-100A) it is assumed that there has been a failure of the primary level instrumentation and/or the PLC and therefore the float switches and hardwired pump control logic shall be used for automatic pump control.
 - c. When the wet well level exceeds the high level float switch level (LSH-100A), Pump #1 shall be started and shall run at 95% speed via the VFD full speed override signal. If the wet well continues to rise and exceeds the high level float switch level (LSH-100B), Pump #2 shall be started and shall run at 95% speed via the VFD full speed override signal. If the wet well continues to rise and exceeds the high level float switch level (LSH-100C), it shall be considered there was a failure in either Pump #1 or Pump #2 in which Pump #3 shall be started and shall run at 95% speed via the VFD full speed override signal. All running pumps shall run until the wet well level drops below the low level float switch (LSL-100A).
 - d. Automatic control shall continue in this manner until manually reset by an operator at the OIT and then automatic pump control shall revert to the primary level instrument.
 - e. A Primary Level Control Enable OIT Switch shall be provided to enable and disable the PLC level control in order to test the hardwired float switch back up level control.
11. Ethernet/IP Data Exchange

- a. The VFD drive shall have a RJ45 Ethernet port that allow for complete data exchange of all VFD parameters over an Ethernet/IP network. The PLC shall poll the VFD parameter and indicate them on the SCADA HMI.
- C. LOOP 102: SEWAGE PUMP #2
 1. Functionally identical to Loop 101.
- D. LOOP 103: SEWAGE PUMP #3
 1. Functionally identical to Loop 101.
- E. LOOP 105: STATION EFFLUENT FLOW
 1. The Station's effluent flow shall be measured by a magnetic type flow transducer (FE-105) that will mounted into the pump station effluent pipe. The flow transducer shall be connected to a flow transmitter (FIT-105) that is hardwired into the RTU-1 PLC and will provide a 4-20ma signal proportional to the flow rate. The flow rate shall be indicated and trended at the OIT and SCADA HMI. The SCADA system shall record the signal (FIR-105).
 2. Four flow totals shall be computed and displayed at the OIT and SCADA HMI.
 - a. Non-resettable total (FQI-105A)
 - b. Previous days total (FQI-105B)
 - c. Current days total (FQI-105C), automatically reset daily
 - d. Resettable total (FQI-105D)
 3. Low flow alarms shall not be active if all of the three pump's check valves are in the closed position.
- F. LOOP 110: BIOXIDE TANK #1 LEVEL
 1. The Bioxide Tank #1 level shall be measured by an ultrasonic level transmitter that produces a 4-20ma signal proportional to the tank level (LIT- 110) and shall be monitored by the RTU-1 PLC via hardwired. The well level shall be indicated and trended at the OIT and SCADA HMI. The SCADA system shall record the signal (LIR-110).
 2. The Bioxide Tank #1 high level shall be monitored by a high level float switch (LSH-110) that shall be hard wired to a Tank Level Alarm Station (LAH-110).
- G. LOOP 111: BIOXIDE TANK #2 LEVEL
 1. Functionally identical to Loop 110.

H. LOOP 112: BOIXIDE TANK LEAK

1. A float switch (LSH-112) located in the Bioxide Tanks containment area and shall be monitored by the RTU-1 PLC via hardwired I/O. Upon activation the leak shall be alarmed and indicated at OIT and SCADA HMI.

I. LOOP 113: EYEWASH/SHOWER

1. The eyewash/shower flow switch (FSH-113) shall be monitored by the RTU-1 PLC via hardwired I/O and upon activation the alarm shall be indicated at the OIT and SCADA HMI.

J. LOOP 115: BIOXIDE PUMP #1

1. The Bioxide Pump #1 shall be monitored and controlled automatically through the RTU-s PLC via hardwired I/O. The Pump shall have Hand/Off/Auto selector switch on the OIT and SCADA HMI, when in the "Auto" or "Hand" positions respectively the remote automatic control and remote manual control through the OIT and SCADA HMI is enabled.
2. The following control, status and alarm signals shall be wired to the PLC I/O and displayed at the OIT and SCADA HMI:
 - a. Bioxide Pump #1 Run status (YI-115)
 - b. Bioxide Pump #1 Start/stop pump (YS-115)
 - c. Bioxide Pump #1 speed (SI-115)
 - d. Bioxide Pump #1 pace control (SC-115)
 - e. Bioxide Pump #1 Alarm (YA-115)
3. Non-resettable elapsed time meter shall be displayed at the OIT and SCADA HMI (KQI-115).
4. A motor state disagreement alarm shall be displayed at the OIT and SCADA HMI if the called state of the motor and the state of the run status contact do not agree after a preset adjustable time (YA-115A). The disagreement alarm is enabled if the H/O/A switch is in the "Auto" position. The disagreement alarm must be manually reset through the OIT and SCADA HMI before Remote Control is enabled.
5. Remote Automatic Control: The pump shall continuously operate (YS-115) and shall be paced (SC-115) to an operator configurable pacing set point proportional to the station flow (FIT-105) with a trim.
6. Remote Manual Control: The Pump is manually start/stopped (YS-115) and VFD speed command (SC-115) is manually entered via the OIT and SCADA HMI.

K. LOOP 116: BIOXIDE PUMP #2

1. Functionally identical to Loop 115.
- L. LOOP 117: BIOXIDE PUMP #3
1. Functionally identical to Loop 115.
- M. LOOP 120: GENERATOR MONITORING
1. The following status and alarms shall be hardwired into the RTU PLC and displayed/annunciated at the OIT and the SCADA HMI:
 - a. Generator on (YI-120A)
 - b. Generator not in auto (YI-120B)
 - c. Generator failure (YA-120A)
 - c. Generator alarm (YA-120B)
 - d. Generator Low Fuel Tank Level (YA-120C)
 - e. Generator Fuel Tank Leak (YA-120D)
 2. The following data shall be polled by the RTU PLC via Modbus TCP from the generator control panel and displayed at the OIT and the SCADA HMI:
 - a. Jacket water temperature
 - b. Lube oil temperature
 - c. Lube oil pressure
 - d. Battery voltage
 - e. RPM
 - f. A.C. Volts per phase
 - g. A.C. Amps per phase
 - h. Frequency
 - i. Elapsed time meter
- N. LOOP 121: TRANSFER SWITCH MONITORING
1. The following status and alarms shall be hardwired into the RTU PLC and displayed/annunciated at the OIT and the SCADA HMI:
 - a. Transfer switch in normal position (YI-121A)

- b. Transfer switch in emergency position (YI-121B)
- c. Loss of utility (normal) power (YI-121C)

O. LOOP 122: UTILITY POWER MONITORING

- 2. The following data shall be polled by the RTU PLC via Modbus TCP from the main switchboards digital power meter and displayed at the OIT and the SCADA HMI:
 - a. A.C. Volts per phase
 - b. A.C. Amps per phase
 - c. Frequency
 - d. Harmonic Distortion
 - e. Watts
 - f. Volt Amperes
 - g. Power Factor
 - h. Demand Watts
 - i. Demand Volt Ampere and
 - j. Watt Hours

P. LOOP 125: RTU-1 PANEL POWER FAILURE

- 1. Loss of the Primary 120 VAC power after 3 seconds to the new RTU control panel (JAL-125A) shall be annunciated at the OIT and SCADA HMI.
- 2. Loss of the Secondary 120 VAC power after 3 seconds to the new RTU control panel (JAL-125B) shall be annunciated at the OIT and SCADA HMI.

Q. LOOP 127: RTU-1 UPS MONITORING

- 1. The following UPS system status and alarms shall be hardwired into the RTU PLC and displayed/annunciated at the OIT and the SCADA HMI:
 - a. UPS ready (JI-127)
 - b. Replace batteries (JAL-127A)
 - c. Buffering (JAL-127B)

R. LOOP 128: 120V MAIN SURGE PROTECTOR FAULT

1. A 120V main surge protector fault in the new RTU control panel (JAL-128) shall be annunciated at the OIT and SCADA HMI.

S. LOOP 130: SECURITY SYSTEM ALARMS

1. The following security system devices provided under Division 16 shall be hardwired into the RTU PLC and displayed/annunciated at the OIT and the SCADA HMI:
 - a. Station intrusion alarm dry contact magnetic door switches (XS-130A)
 - b. Generator enclosure intrusion alarm dry contact magnetic door switches (XS-130B)
 - c. Wet Well intrusion dry contact limit switch (XS-130C)
 - d. Station lower level fire alarm dry contact heat detectors (TSH-130D)
 - e. Station upper level fire alarm dry contact heat detectors (TSH-130E)
 - f. Station help call (YA-130D)
2. Provide a timed entry/exit alarm delay for the Station intrusion alarm (XS-130A) that allows the operator to enter a 4 character code to arm and disarm all of the intrusion alarms.

T. LOOP 135: STATION FLOOD ALARM

1. A float switch (LSH-135) will be located in the lower level and shall be hardwired into the RTU PLC. When activated the alarm shall be annunciated at the OIT and the SCADA HMI:

U. LOOP 136: STATION TEMPERATURE MONITORING

1. A temperature indicating transmitters (TIT-136A, TIT-136B) located on the station's upper level and lower level walls respectively and shall be connected to the RTU PLC I/O via hardwired I/O. The temperatures shall indicated at the OIT and SCADA HMI.
2. The temperatures shall be trended and recorded (TIR-136A, TIR-136B) at the SCADA HMI.
3. Low and High temperature alarms (TAL-136A, TAH-136A, TAL-136B, TAH-136B) shall be based on OIT and SCADA HMI entered temperature alarm setpoints.

V. LOOP 140: HVAC SYSTEM MONITORING

1. The following HVAC system status and alarms shall be hardwired into the RTU PLC and displayed/annunciated at the OIT and the SCADA HMI:

- a. RTU-1, HVAC Unit running (YI-140)
- b. RTU-1, HVAC Unit Alarm (YA-140)

PART 2 – PRODUCTS

2.01 INSTRUMENTATION 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 mAdc.
- D. All signal converters, isolation transformers, uninterruptible power supplies (UPS), power regulators, or power converters shall be the responsibility of the instrument supplier. The loop descriptions herein do not specify all hardware required for proper operation. It is the responsibility of the Instrumentation supplier to furnish and install all necessary equipment for complete systems.
- E. All equipment necessary to complete the functional requirements of this Section shall be supplied by the Instrumentation and Control System Supplier and be of the same manufacturer unless otherwise specified (e.g. signal converters, integrators, computing devices alarm trips etc.) shall be of the same manufacturer as the recorders, controllers and indicators.
- F. All necessary fuses or switches required by the Instrumentation and Control System Supplier for his equipment shall be provided with the equipment. All instruments requiring an external power supply shall have an internal ON-OFF switch.
- G. Indicator, recorders, controllers, integrators, relays, and other receiving devices, when operating in a loop shall be of a design such that a failure of an individual device shall not effect the operation and integrity of the remaining loop functions. All indicators, recorders either remote or panel mounted shall have an individual internal on/off switch.
- H. Electronic transmitting equipment shall provide loop power. True 2-wire transmitter may have its loop power supplied in the receiving instrument, if available, or by a plug in power supply mounted in the receiving instrument panel.
- I. All conductors running from the field to the control panel shall be of a single, continuous length, without splices except at approved junction boxes. The junction boxes shall have terminal blocks with 20 percent spares in addition to terminals for all wires including spare wires. Special care shall be exercised to carry grounding lines through such junction boxes with the least possible resistance.
- J. Multi-conductor cable may be used between junction boxes and control panels.
- K. 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.

- L. All field electronics and outdoor control panel equipment shall be suitable for operation in ambient temperatures of -40 degrees F to 140 degrees F. All indoor control panel located electronics shall be suitable for operation in ambient temperatures of 40 degrees F to 120 degrees F.
- M. All external connection points shall be made at terminal blocks with No. 6-32 or larger screws.
- N. Nameplates shall be provided on all field mounted transmitters, level relays, control panels, indicators, etc. Nameplates shall be identical to those specified for Control Panels.

2.02 CONTROL PANELS

- A. Control panels shall be per the control panel list at the end of this Section.
- B. Control panels shall be fabricated per drawings I-1xx thru I-1xx and specification 17320.
- C. The RTU Control panel shall have a primary and secondary 120VAC power fed into the panel. A power transfer relays shall be provided to automatically transfer the 120VAC panel power from primary power to secondary power upon loss of the primary power and transfer back to primary power upon its restoration.

2.03 PROGRAMMABLE LOGIC CONTROLLERS (PLC's):

- A. PLC equipment shall be furnished and installed per drawings and I-XXX thru I-XXX. and specification 17320.
- B. The PLC programming shall be provided by the owner's consultant Woodward and Curran.

2.04 OPERATOR INTERFACE TERMINAL (OIT)

- A. OIT equipment shall be furnished and installed per drawings and I-XXX thru I-XXX. and specification 17320.
- B. The OIT programming shall be provided by the owner's consultant Woodward and Curran.

2.05 EQUIPMENT

- A. The INSTRUMENT LOOP DESCRIPTION, DIAGRAMS, AND INSTRUMENT LIST included at the end of this section indicate the intent of the process and interconnection between INSTRUMENTS. EQUIPMENT specified herein does not purport to cover all equipment that may be required to complete the process intent. Numbering identification is based on ISA standard. The instrument index sheets included within this section of the specifications have been furnished to summarize the system equipment and to list the operating parameters for this equipment. This list may not completely include all the required equipment necessary for a completely operational system. The instrument supplier shall provide all necessary equipment required in order to perform the function for the system.
- B. INDUSTRIAL ETHERNET SWITCH
 - 1. The industrial Ethernet Switch shall be minimum 8 port and furnished and installed per drawings and I-XXX thru I-XXX. and specification 17320.
- C. ELECTRICAL RELAYS
 - 1. Electrical relays for handling power circuits shall be general purpose equal to IDEC, Omron, Allen-Bradley, Potter & Brumfield, or approved equal. Relays handling control, telemetering or alarm functions shall be general-duty, plug-in type, complete with dust and moisture proof enclosure equal to IDEC, Omron,

Allen-Bradley, Phoenix Contact, Potter & Brumfield, or approved equal. Units shall be provided with integral indicating light to indicate if relay is energized. Units shall have DPDT relay contacts and be rated for 10 A at 120 VAC, 10 A at 24 VDC

2. Time delay relays shall have DPDT relay contacts and be suitable for on-delay or off-delay operation. Rated load shall be 10 A at 120 VAC, 10 A at 24 VDC. Units shall be provided with integral time-delay adjustment knob. Relays shall be provided with dust and moisture resistant covers. Relays shall be suitable for operating in a temperature range from -30° to 55° C. Units shall be adjustable and available in a single range or multiple ranges from 0.1 second to 10 hours. Time delay relays shall be UL listed. Mounting sockets matched to relay and mounting rails/holders shall be provided as required. Time delay relays shall be as manufactured by IDEC, Allen Bradley, or Engineer-approved equal.

D. CURRENT-TO-CURRENT CONVERTERS

1. Current to current converters shall transform a current input signal (1-5, 4-20, or 10-50 mA) to a proportional 4-20 mA current output signal. The unit shall be of solid state electronic circuitry sealed in a protective epoxy compound, and shall be for surface or rear of panel mounting.
2. Current to current converters shall provide signal conversion capabilities, input/output isolation and output power boosting.
3. Signal output drive capability shall be 4-20 mA into 600 ohms load.
4. Accuracy shall be 0.25 percent of span.

E. INTRINSICALLY SAFE PANEL

1. Provide a panel to house intrinsically safe current isolator for a future submersible level transmitter and intrinsically safe relays for float switches. The panel shall have din-rail mounting terminal strips for all wiring and shall receive 24VDC power from the RTU control panel.
2. Intrinsically Safe Current Isolators
 - a. Din rail mounted intrinsically safe current isolators shall be furnished for interconnection of each wetwell level transmitters.
 - b. Operating voltage shall be 24 VDC.
 - c. The intrinsically safe control circuit shall be approved by Factory Mutual and the Canadian Standards Association for Class 1, 119 111; Division 1; Groups A, B, C, D, E, F, G hazardous locations.
3. Intrinsically Safe Relays (IS Relays)
 - a. Din rail mounted intrinsically safe relays shall be furnished for

interconnection of each float switch located in the wet well.

- b. Operating voltage shall be 24VDC
- c. Load contacts shall be double pole, double throw and shall be rated for 10 amperes resistive load or 3 amperes inductive load at 120 VAC.
- d. The intrinsically safe control circuit shall be approved by Factory Mutual and the Canadian Standards Association for Class 1, 119 111; Division 1; Groups A, B, C, D, E, F, G hazardous locations.

F. LIGHTNING/SURGE PROTECTION

- 1. Lightning/surge protection shall be provided to protect the instrumentation system from induced surges propagating along the signal and power supply lines. The protection systems shall be such that the protective level shall not interfere with normal operation, but shall be lower than the instrument surge withstand level, and be maintenance free and self-restoring. Ground wires for all surge protectors shall be connected to a good earth ground and where practical each ground wire run individually and insulated from each other.
- 2. Protection of all 120 volt AC instrument cabinet power supply lines and individual field instruments shall be provided. Cabinets shall be protected by isolation transformers and surge suppressers.
- 3. The unit shall be back panel mounted and is to be connected between the telephone line and the telemetry and control equipment. Transient voltages above 90V line to ground or 180V line to line will cause the gas discharge tubes to short to ground. If the peak lasts more than an instant, 1/4 amp fast blow fuses will open the line.
- 4. Protection of circuits connected over leased or private telephone lines shall be provided with surge and lightning protectors at signal terminal in addition to the normal fused lightning arrestor supplied by the telephone company.
- 5. Lightning/surge protection units shall be as manufactured by Joslyn Industries or equal.
- 6. All remote loop powered transmitters shall be provided with close-nippled lightning/surge protection units. The loop shall be terminated at the receiving device/panel with a receiving end lightning/surge protection unit. This shall be provided to all remote equipment for this project.

F. POWER SUPPLIES

1. The Power Supplies shall be furnished and installed per drawings and I-XXX thru I-XXX. and specification 17320.

- G. Indicating Lights: Indicating lights shall be 30 mm NEMA, high-intensity LED, push-to-test type, by Allen-Bradley or Engineer approved equal.

2.06 ULTRASONIC FLOW METER – CLAMP ON

A. Flow Element (FE)

1. Type: Clamp on design, externally mounted to pipe.
2. Operation:
 - a. Purpose - To produce a low-level voltage output signal proportional to flow rate.
 - b. Operating Principle - Transit time flow measurement technique with an alternate Doppler measurement technique for liquids with high air or solid content. The meter shall auto toggle from Transit Time measurement to Doppler measurement if the signal decays due to high air or solid content, and toggle back automatically when the Transit Time signal recovers. The Transit Time/Doppler measurement shall be accomplished with a single set of flow transducers and with the use of only one metering channel.
3. Functional:
 - a. Power Requirement - supplied by magnetic flow converter.
 - b. Max Power Consumption – 15 Watts.
 - c. Electrical Class - NEMA 4X.
4. Physical:
 - a. Transducer - Encased in fully sealed, watertight, stainless steel with integral armored stainless steel jacketed TRIAX cable. Provide manufacturer's coupling pads and stainless steel transducer track mounting system for permanent pipe installations. Frequent application of coupling pastes shall not be required for successful application.

B. Flow Indicating Transmitter (FIT)

1. Type:
 - a. Liquid crystal display with rate and total.

b. 4-20 mA DC Output.

2. Operation:

a. Purpose - Provides power to the ultrasonic transducer and convert the signal from the transducer 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 - Signal input from transducer.

b. Power Requirement - 120 VAC \pm 10%, 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. Accuracy - \pm 0.5% of rate.

2. Documentation Required -Wet flow calibration certificate accredited from an international standards agency with an accuracy of better than 1%.

3. All calibration and transducer data must reside on a non-volatile memory chip located in the transducer junction box or flow meter.

D. Manufactures; Endress & Hauser, Krohne, Siemens, or equal

2.07 BUBBLER SYSTEM LEVEL MONITORING PANEL

A. The bubbler system level monitoring panel shall be a fully automatic bubbler system for wastewater applications. The system shall be provided in a single panel with dual air compressors, air tank, bubbler purge line, automatic air tank moisture drain, a pressure transmitter with a 4-20ma signal proportional to level based on pressure sensed in the wetwell.

- B. The system shall come complete in a single NEMA 4 control panel with 120VAC input power, two internal fused compressors, solenoid, valve, air storage tank, level pressure transmitter, tank air pressure transmitter, pressure regulators, air filter, operator interface terminal, controllers, door mounted 3” graphic display OIT, and power supply.
- C. The system shall have a manual air purge system with door operated pushbutton.
- D. The system alarms shall include high wet well level, low wet well level, air compressor 1 alarm, air compressor 2 alarm, air tank low pressure alarm and have a door mounted alarm reset pushbutton. A general alarm dry contact for interface to remote indication shall be provided.
- E. The system controller shall all the following functions:
 - 1. Compressor on/off setpoint settings, based on tank air pressure
 - 2. Manual and automatic compressor alternation
 - 3. Automatic compressor alternation upon compressor failure
 - 4. Air compressor safe mode which limits the continuous run time of each of the air compressor.
 - 5. Attempts to clear clogged bubbler tube before alarming
 - 6. Freezes level analog output during purging
 - 7. Automatic bubbler line purge and air tank drain cycle performed at an interval of 6 hours (factory set). The time interval is field adjustable.
- F. The door mounted OIT shall indicate the following:
 - 1. Wet well level
 - 2. Air tank pressure
 - 3. Compressor running
 - 4. Compressor run time
 - 5. System purging
 - 6. Air tank moisture drain active
 - 7. Air compressor failure
 - 8. Clogged bubbler tube indication

- G. The air system shall have bottom panel mounted intake air and 1/2" NPT wet well tube connections.
- H. Provide factory recommended stainless steel air tubing from the bubbler system level monitoring panel into the wet well and extending to approximately 12" from the bottom.
- I. The bubbler system level monitoring panel shall be a LDBCS-A-I-N4-C-S by PCP Pump & Process, or equal by other manufacturers.

2.08 LEVEL TRANSMITTERS – ULTRASONIC (Chemical Tanks)

- A. Level transmitter shall be Siemens Milltronics Probe non-contacting ultrasonic liquid level transducer and transmitter or Engineer approved equal.
- B. Transmitter shall be 3-wire, powered 18 to 30 VDC with a measurement range of 0.8 to 16.4 feet and a 12 degree measurement angle.
- C. Transmitter output to be 4-20 mA DC current loop into 750 ohms maximum load at 24 VDC, $\pm 0.25\%$ of target range resolution.
- D. Transmitter housing shall have a IP65 rating.
- E. Transmitter shall be rated CE, CSA, and FM for general uses.
- F. Unit shall be provided with built in temperature compensation.

2.09 LEVEL SWITCH - FLOAT TYPE

- A. Float switches shall be of non-mercury snap switch type, completely metal capsules rated for switching 14 ampere loads at 120 VAC that activates at 2" of water. Switches shall be made of high impact plastic with detachable floor mounting base and over protective cover. Switches shall include 28" of marine grade No. 14 AWG wire. Switches shall be installed per the manufacturer's requirements.
- D. Level switches shall be model 40A as manufactured by Rule, or equal.

2.10 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

2.11 TEMPERATURE INDICATING TRANSMITTER

- A. The temperature indicating transmitter shall provide a 4-20 mA output that is linear to the measured ambient temperature, with a temperature sensing range of 0 to 100 degrees

Fahrenheit. Accuracy shall be 0.5% of the span. Temperature sensor shall have a local LED display of temperature. The temperature sensor shall be UL listed.

- B. Temperature indicating transmitter shall be loop powered, 13 to 40 vDC.
- C. Temperature indicating transmitter shall be Model RTTI as manufactured by Devar, Inc. or equal.

2.12 PENDANT CORD OPERATOR STATION

- A. UL Listed NEMA 6 Rated pendant cord operator with an emergency stop maintained pushbutton and a spring return run pushbutton.
- B. Operator station housing and cover shall be constructed of steel reinforced neoprene with a safety yellow color.
- C. Cable stress relief shall be built into the housing.
- D. Provide a 50 foot cable, the outer jacket of the cable shall be of chlorinated polyethylene (CPE) and be oil, water, and UV resistant, capable of continuous submerged operation underwater to a depth of 65 feet.

2.13 TANK LEVEL ALARM STATIONS

- A. Provide tank level alarm stations consisting of a 120VAC red alarm beacon mounted on a NEMA 4X stainless steel enclosure. The stations shall be pre-wired with din rail mounted terminal blocks for field connections of power and high level float switch.

2.14 RADIO TELEMETRY EQUIPMENT

- A. Radio Modem: Provide a Cap-Amp Viper Radio modem and mounted in the new RTU control panel.
- B. Antenna
 - 1. Provide a Heavy Duty 3dB gain fiberglass Yagi directional antenna. Antenna shall be directed at existing system master station.
 - 2. Antenna shall be provided with a new base mounting equipment with pass through cable connection and NPT threaded nipple for connection to 1 ¼" rigid conduit.
- C. Antenna Cable
 - 1. Provide LMR400 or engineer approved equal coaxial antenna cables of sufficient length to connect the antenna to the radio IP router at each site. Antenna cables shall be installed within the conduit. Provide VHF50HN Polyphaser, or Engineer approved equal, surge protection equipment for the antenna cable at each site.

2. Cabling to the antenna from the radio IP router shall be run in conduit in accordance with DIVISION 16 - ELECTRICAL requirements, to provide for physical protection from damage.

D. Surge Protection Equipment

1. Provide a PolyPhaser or equal lightning arrestor for connection to the antenna cable installed in a dedicated junction box panel. The lightning arrestor shall meet the following requirements:
 - a. Throughput energy: less than or equal to 600 μ J for a 50kA 8/20 μ s waveform
 - b. Insertion loss: less than or equal to 0.1 dB over the frequency range

2.15 SPARE PARTS

- A. Spare parts shall be provided as a part of the start-up services during the initial start-up and phase-in period. These items shall include the spare parts as required by specification 17320 and accessories such as fuses, circuit breakers, power supplies, I/O cards, lights, etc. required to start-up and operate the system for a period of 60 days. These items shall be packaged in separate containers and shipped to the job site with the instruments and shall be tagged "INSTRUMENT START-UP EQUIPMENT".
- B. Spare parts above and beyond those being provided for start-up services shall be provided under this Section. All spare parts shall be packaged and shipped at one time. Separate shipment of spare parts shall not be acceptable. The Engineer shall be notified of the shipment release in writing indicating that all items have been shipped. Each item shall be checked by the Engineer as being received and that all components have been provided as specified.
- C. Furnish one box of spare fuses of each type supplied. A box shall consist of a minimum of 12 fuses.

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 shop practices for the instrument 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 instrument foreman.
- D. All wiring and piping shall be constructed perfectly plumb, square, level, and true to lines and surfaces indicated in a neat, substantial and workmanlike manner, and in such a way as to properly serve for the purpose intended. All members and parts, upon installation,

shall be properly framed, secured together and anchored in place. All cuts shall be deburred and immediately cleaned from opposite end before connecting.

- E. All instruments shall be mounted, piped and connected in strict accordance with the manufacturer's instructions.
- F. All internal wiring of the instrument panel shall be done by the panel manufacturer in accordance with the drawings and instrument manufacturer's instructions.
- G. The loops on the drawings and the instrument specifications and index sheets indicate the intent of the interconnections between and the type of individual instrument. The proposed equipment shall be complete with all mounting hardware and accessories to satisfy the functional requirements.
- H. All work shall be executed in full accordance with codes and local rulings. Should any work be performed contrary to said rulings, ordinances and regulations, the Instrumentation Contractor shall bear full responsibility for such violations and assume all costs arising therefrom.
- I. All piping to and from field instrumentation shall be provided with necessary unions, test tees and shut-offs.
- J. Interfacing fixtures shall be compatible with the equipment to which they are attached and shall comply with the applicable specifications.
- K. In-line devices, flow or level elements, specified herein shall be installed under DIVISION 15 - MECHANICAL.
- L. Wiring of in-line devices, flow or level elements, specified herein shall be installed under DIVISION 16 - ELECTRICAL.
- M. Coordination with the process and equipment in addition to standard quoted fixtures require to conform the instrumentation to the process shall be the responsibility of the General Contractor. The Instrumentation Contractor shall provide detail information on the fixtures being supplied and the extent of the field installation required.
- N. Brackets and hangers required for mounting of equipment shall be provided as noted on the drawings or as required. They shall be done in a workmanlike manner and not interfere with any other equipment.
- O. Investigate each space in the building 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 building.
- P. The shield on each process instrumentation cable shall be grounded as directed by the manufacturer of the instrumentation equipment but in no case shall more than one ground be employed for each shield.
- Q. Maximum practical separation shall be maintained between signal (analog, alarm, and status) conduits and power feeders and AC systems.

- R. All conductors running from the field to the control panel shall be a single, continuous length without splices, except at approved junction boxes. The junction boxes shall have terminal blocks with 20% spare in addition to terminals for all wires including spare wires. Special care shall be exercised to carry grounding lines through such junction boxes with the least possible resistance.
- S. Multi-conductor cable may be used between junction boxes and control panels.
- T. All field conductors shall terminate at the control panel terminal board. Millivolt signal wires (i.e., thermocouple) may be connected direct to the input terminals of the receiving instrument if so specified.
- U. All wire ends shall be terminated with hook fork type non-split compression lugs.
- V. All wire ends shall be identified at both ends with wire markers.
- W. Entry to field enclosures shall be through the back, side, or bottom (not top) with weatherproof hubs. Wiring shall enter near the terminal point and not obstruct access to removal of components.
- X. 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 START-UP

- A. Prior to final connection to the main instrument control panel, the Instrumentation Contractor shall thoroughly clean all work completed including the interior of all panelboards; and remove all dirt, trash, and foreign material. The outside of all instrument panelboards are to be cleaned and damaged painted surfaces touched up as required to leave the equipment in an acceptable condition. This shall include all nameplates, tags, and identification of equipment and devices within or on the front of the panels.
- B. It shall be the responsibility of the vendor to provide a factory trained and qualified serviceman from the manufacturer's of the equipment to TEST AND CALIBRATE ALL EQUIPMENT and to INSTRUCT the Contractor on EQUIPMENT INSTALLATION and the ENGINEER on operation of the equipment.
- C. No other instrumentation system manufacturer's personnel other than those persons directly from the service department of the manufacturer of the equipment shall be acceptable to perform this work.
- D. The start-up services shall be performed by qualified personnel from the service department of the equipment manufacturer with a minimum of five years experience on the equipment being provided by this contract, or equal.
- E. During the start-up, the Instrumentation shall provide sufficient personnel to aid with the start-up of the instrument and control equipment to be provided and installed by this Section and by this Contract. This shall include services to correct any faults and to make the necessary adjustments for the proper operation of the equipment and

installation.

3.03 TESTING AND CALIBRATING

- A. Testing and calibration of equipment shall be done in the presence of the Engineer.
- B. Prior to electrical check out all breakers, switches and similar disconnect devices shall be placed in the off position.
- C. The panel and other equipment grounding shall be verified.
- D. Visual inspection and continuity testing shall be made to verify that no damaging wiring errors occur between power and signal wiring.
- E. The systems shall be checked for improper or accidental grounding.
- F. Each system and component shall be energized and their inputs simulated. The output shall be checked to verify the proper calibration and interaction with associated hardware.
- G. Hypotting shall not be permitted on instrument systems unless specific instructions are given to safeguard electronic equipment from damage.
- H. Prior to actuating a final control element (valve, level actuator, or variable frequency drive) the Instrumentation Contractor shall obtain the permission of the General Contractor and any other involved contractors to prevent damage to associated equipment.
- I. The factory serviceman shall verify the calibration and direction of the final control element in accordance with the requirements for each portion of the system.
- J. Instrument and control calibration and control loop checkout shall be the responsibility of the manufacturer of the equipment.
- K. The Instrumentation Contractor shall arrange for and obtain the services of a factory trained service qualified engineer from the manufacturer's of the equipment to perform the calibration and commissioning of the entire system.
- L. Each instrument shall be calibrated at 10 percent, 50 percent, and 90 percent using test instruments that are rated to an accuracy of at least five times greater than the instrument being checked. The test instrument shall have its accuracy traceable to the National Bureau of Standard as applicable.
- M. Upon completion of the work, the Instrumentation Contractor shall demonstrate to the Owner the proper operation of all equipment and systems.
- N. The Instrumentation Contractor submit to the Engineer all test data, inspection test certificates, manufacturers' warranties certified calibration data, certified prints, manufacturers' installation, operation and maintenance manuals, electrical wiring and control diagrams with all noted field modification for an as-built record for the system, and required and suggested spare parts lists.

- O. A factory test shall be scheduled by the instrumentation system manufacturer for the entire system. A simulated system layout which shall include all equipment and interconnections shall be arranged to perform all system functions. The testing shall be performed in the presence of the Engineer. A two week written notification shall be provided to the Engineer to allow for scheduling the testing.
- P. Upon completion and satisfactory performance an approval notification shall be provided for this portion of the work for this Section. No equipment shall be allowed to be shipped from the factory without approval for this portion of the work.

3.04 MANUFACTURER'S SERVICES

- A. The supervisory service of a factory-trained service engineer who is specifically trained on the type of equipment herein specified shall be provided for a period of not less than four 8-hour days during construction to assist the Instrumentation and Electrical Contractors 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. Upon completion of the installation, the services of the above service engineer shall be provided for a period of not less than six 8-hour days for calibration, testing and start-up of the equipment. The instrumentation system supplier shall conduct a group training program on the operation and routine maintenance of the system. The training shall be conducted at the installation site and consist of five classroom and field training sessions, 8 hours a day during normal working hours. The text shall be the loop diagrams, operation and maintenance manual and shall concentrate on the operation of the equipment as applied to this process. The minimum days specified above do not relieve the manufacturer of providing sufficient service to place the system in satisfactory operation.

3.05 PRODUCT HANDLING

- A. Upon completion of shop assembly and testing, all control panels shall be enclosed in heavy-duty polyethylene envelopes or secured sheeting to provide complete protection from dust and moisture. Dehumidifiers shall be placed inside the polyethylene coverings. The equipment shall then be skid-mounted for final transport. Lifting rings shall be provided for moving the equipment without removing protective covering. Boxed weights shall be shown on shipping tags together with instructions for unloading, transporting, storing and handling at the job site.
- B. 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.
- C. 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.
- D. A permanent stainless steel or other noncorrosive material tag firmly attached and permanently and indelibly marked with the instrument tag number as given in the tabulation shall be provided on each piece of equipment supplied under this section.

- E. 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 Instrumentation Contractor at his own cost and expense. If any apparatus has been subject to possible injury by water, it shall be thoroughly dried out and put through such tests as directed by the Engineer. This shall be at the cost and expense of the Instrumentation Contractor or the apparatus shall be replaced by the Instrumentation Contractor at his own expense.

3.06 GUARANTEE

- A. For guarantee, refer to General Conditions.

CONTROL PANEL AND OPERATOR STATION LIST										
Designation	Description	Location	NEMA Rating	Material	Min. Height	Min. Width	Min. Depth	Mounting	UPS	OIT
RTU-1	Worcester Road Sewer Pumping Station SCADA RTU	Worcester Road Sewer Pumping Station	4	Steel	48-in	36-in	12-in	Wall	YES	YES
ISP-1	Worcester Road Sewer Pumping Station Intrinsically Safe Panel	Worcester Road Sewer Pumping Station	4	Steel	12-in	12-in	6-in	Wall	NO	NO
OS-101	Sewage Pump #1 Operator Station	Worcester Road Sewer Pumping Station Lower Level	6	Steel Reinforced Neoprene	4-in	2-in	2-in	Pendant Cord	NO	NO
OS-102	Sewage Pump #2 Operator Station	Worcester Road Sewer Pumping Station Lower Level	6	Steel Reinforced Neoprene	4-in	2-in	2-in	Pendant Cord	NO	NO
OS-103	Sewage Pump #3 Operator Station	Worcester Road Sewer Pumping Station Lower Level	6	Steel Reinforced Neoprene	4-in	2-in	2-in	Pendant Cord	NO	NO

INSTRUMENTATION LIST

TAG #	FACILITY	FUNCTION	INSTRUMENT	TYPE	LOCATION	RANGE	UNITS	REMARKS
LIT-100	Worcester Road Sewer Pumping Station	Wet Well Level	Level Transmitter	Bubbler Level Monitoring System	Upper Level	0-20	FT	
LSH-100A	Worcester Road Sewer Pumping Station	Wet Well High Level	Level Switch	Float Switch	Wet Well	N/A	N/A	Provide Intrinsically Safe Relay Barrier
LSH-100B	Worcester Road Sewer Pumping Station	Wet Well High/High Level	Level Switch	Float Switch	Wet Well	N/A	N/A	Provide Intrinsically Safe Relay Barrier
LSH-100C	Worcester Road Sewer Pumping Station	Wet Well High/High/High Level	Level Switch	Float Switch	Wet Well	N/A	N/A	Provide Intrinsically Safe Relay Barrier
LSI-100A	Worcester Road Sewer Pumping Station	Wet Well Low Level	Level Switch	Float Switch	Wet Well	N/A	N/A	Provide Intrinsically Safe Relay Barrier
LSI-100B	Worcester Road Sewer Pumping Station	Wet Well Low/Low Level	Level Switch	Float Switch	Wet Well	N/A	N/A	Provide Intrinsically Safe Relay Barrier
FE-105	Worcester Road Sewer Pumping Station	Station Effluent Flow	Flow Element	Ultrasonic Strap On	Station Effluent Flow	0-x000	GPM	--
FIT-105	Worcester Road Sewer Pumping Station	Station Effluent Flow	Flow Transmitter	Electronic	Station Effluent Flow	0-x000	GPM	--
LIT-110	Worcester Road Sewer Pumping Station	Bioxide Tank #1 Level	Level Transmitter	Ultrasonic Level Transmitter	Bioxide Tank #1	0-10	Feet	-
LSH-110	Worcester Road Sewer Pumping Station	Bioxide Tank #1 Level High Level	Level Switch	Float Switch	Bioxide Tank #1 Level	N/A	N/A	-
LAH-110	Worcester Road Sewer Pumping Station	Bioxide Tank #1 Level High Level Alarm	Tank Level Alarm Station	Level Alarm Station	Bioxide Tank #1	--	--	--
LIT-111	Worcester Road Sewer Pumping Station	Bioxide Tank #2 Level	Level Transmitter	Ultrasonic Level Transmitter	Bioxide Tank #2	0-10	Feet	-
LSH-111	Worcester Road Sewer Pumping Station	Bioxide Tank #2 Level High Level	Level Switch	Float Switch	Bioxide Tank #2 Level	N/A	N/A	-

INSTRUMENTATION LIST

TAG #	FACILITY	FUNCTION	INSTRUMENT	TYPE	LOCATION	RANGE	UNITS	REMARKS
LAH-111	Worcester Road Sewer Pumping Station	Bioxide Tank #2 Level High Level Alarm	Tank Level Alarm Station	Level Alarm Station	Bioxide Tank #2	--	--	--
LSH-112	Worcester Road Sewer Pumping Station	Bioxide Tank Leak	Level Switch	Lifting	Bioxide Tank Containment Area	--	--	--
LSH-135	Worcester Road Sewer Pumping Station	Station Flood	Level Switch	Float Switch	Lower Level	N/A	N/A	-
TIT-136A	Worcester Road Sewer Pumping Station	Station Upper Level Temperature	Temperature Ind/Transmitter	Electronic	Upper Level	0-100	Degrees F	-
TIT-136B	Worcester Road Sewer Pumping Station	Station Lower Level Temperature	Temperature Ind/Transmitter	Electronic	Lower Level	0-100	Degrees F	-

IO AND ALARM LIST

IO Tag No	Service	Location	IO Description	IO Type	IO Signal Range	CP Termination	LRL	URL	Units	Alarm List	Remarks
LT-100	Station Wet Well Level	Worcester Road Sewer Pumping Station Wet Well	Wet Well Level	AI	4-20 mA DC	RTU-1	0	20	Feet	TRUE	LAHH, LAH, LAL, LALL,
YA-100	Station Wet Well Level	Worcester Road Sewer Pumping Station Wet Well	Bubbler System Alarm	DI	--	RTU-1	--	--	--	TRUE	--
LSH-100A	Station Wet Well High Level	Worcester Road Sewer Pumping Station Wet Well	Wet Well Level High	DI	--	RTU-1	--	--	--	TRUE	--
LSH-100B	Station Wet Well High Level	Worcester Road Sewer Pumping Station Wet Well	Wet Well Level High/High	DI	--	RTU-1	--	--	--	TRUE	--
LSH-100C	Station Wet Well High Level	Worcester Road Sewer Pumping Station Wet Well	Wet Well Level High/High/High	DI	--	RTU-1	--	--	--	TRUE	--
LSL-100A	Station Wet Well Low Level	Worcester Road Sewer Pumping Station Wet Well	Wet Well Level Low	DI	--	RTU-1	--	--	--	TRUE	--
LSL-100B	Station Wet Well Low Level	Worcester Road Sewer Pumping Station Wet Well	Wet Well Level Low/Low	DI	--	RTU-1	--	--	--	TRUE	--
YI-101A	Station Sewage Pump #1	Worcester Road Sewer Pumping Station	Pump #1 HOA in Auto	DI	--	RTU-1	--	--	--	FALSE	--
YI-101B	Station Sewage Pump #1	Worcester Road Sewer Pumping Station	Pump #1 Run Status	DI	--	RTU-1	--	--	--	FALSE	--
YI-101C	Station Sewage Pump #1	Worcester Road Sewer Pumping Station	Pump #1 in Bypass	DI	--	RTU-1	--	--	--	FALSE	--
MSH-101	Station Sewage Pump #1	Worcester Road Sewer Pumping Station	Pump #1 Seal Chamber Leak	DI	--	RTU-1	--	--	--	TRUE	--
TAH-101	Station Sewage Pump #1	Worcester Road Sewer Pumping Station	Pump #1 High Motor Temperature	DI	--	RTU-1	--	--	--	TRUE	--
YA-101A	Station Sewage Pump #1	Worcester Road Sewer Pumping Station	Pump #1 VFD Alarm	DI	--	RTU-1	--	--	--	TRUE	--
YA-101B	Station Sewage Pump #1	Worcester Road Sewer Pumping Station	Pump #1 Soft Starter Alarm	DI	--	RTU-1	--	--	--	TRUE	--
OS-101	Station Sewage Pump #1	Worcester Road Sewer Pumping Station	Pump #1 Emergency Stop	DI	--	RTU-1	--	--	--	TRUE	--
ZSA-101	Station Sewage Pump #1	Worcester Road Sewer Pumping Station	Pump #1 Check Valve Failure	DI	--	RTU-1	--	--	--	TRUE	--
PSA-101	Station Sewage Pump #1	Worcester Road Sewer Pumping Station	Pump #1 Water Seal Failure	DI	--	RTU-1	--	--	--	TRUE	--

IO AND ALARM LIST

IO Tag No	Service	Location	IO Description	IO Type	IO Signal Range	CP Termination	LRL	URL	Units	Alarm List	Remarks
SI-101	Station Sewage Pump #1	Worcester Road Sewer Pumping Station	Pump #1 VFD Speed	AI	4-20 mA DC	RTU-1	0	100	%	FALSE	--
YS-101	Station Sewage Pump #1	Worcester Road Sewer Pumping Station	Pump #1 Start/Stop	DO	--	RTU-1	--	--	--	FALSE	--
SC-101	Station Sewage Pump #1	Worcester Road Sewer Pumping Station	Pump #1 VFD Speed Command	AO	4-20 mA DC	RTU-1	30	100	%	FALSE	--
YI-102A	Station Sewage Pump #2	Worcester Road Sewer Pumping Station	Pump #2 HOA in Auto	DI	--	RTU-1	--	--	--	FALSE	--
YI-102B	Station Sewage Pump #2	Worcester Road Sewer Pumping Station	Pump #2 Run Status	DI	--	RTU-1	--	--	--	FALSE	--
YI-102C	Station Sewage Pump #2	Worcester Road Sewer Pumping Station	Pump #2 in Bypass	DI	--	RTU-1	--	--	--	FALSE	--
MSH-102	Station Sewage Pump #2	Worcester Road Sewer Pumping Station	Pump #2 Seal Chamber Leak	DI	--	RTU-1	--	--	--	TRUE	--
TAH-102	Station Sewage Pump #2	Worcester Road Sewer Pumping Station	Pump #2 High Motor Temperature	DI	--	RTU-1	--	--	--	TRUE	--
YA-102A	Station Sewage Pump #2	Worcester Road Sewer Pumping Station	Pump #2 VFD Alarm	DI	--	RTU-1	--	--	--	TRUE	--
YA-102B	Station Sewage Pump #2	Worcester Road Sewer Pumping Station	Pump #2 Soft Starter Alarm	DI	--	RTU-1	--	--	--	TRUE	--
OS-102	Station Sewage Pump #2	Worcester Road Sewer Pumping Station	Pump #2 Emergency Stop	DI	--	RTU-1	--	--	--	TRUE	--
ZSA-102	Station Sewage Pump #2	Worcester Road Sewer Pumping Station	Pump #2 Check Valve Failure	DI	--	RTU-1	--	--	--	TRUE	--
PSA-102	Station Sewage Pump #2	Worcester Road Sewer Pumping Station	Pump #2 Water Seal Failure	DI	--	RTU-1	--	--	--	TRUE	--
SI-102	Station Sewage Pump #2	Worcester Road Sewer Pumping Station	Pump #2 VFD Speed	AI	4-20 mA DC	RTU-1	0	100	%	FALSE	--
YS-102	Station Sewage Pump #2	Worcester Road Sewer Pumping Station	Pump #2 Start/Stop	DO	--	RTU-1	--	--	--	FALSE	--
SC-102	Station Sewage Pump #2	Worcester Road Sewer Pumping Station	Pump #2 VFD Speed Command	AO	4-20 mA DC	RTU-1	30	100	%	FALSE	--
YI-103A	Station Sewage Pump #3	Worcester Road Sewer Pumping Station	Pump #3 HOA in Auto	DI	--	RTU-1	--	--	--	FALSE	--

IO AND ALARM LIST

IO Tag No	Service	Location	IO Description	IO Type	IO Signal Range	CP Termination	LRL	URL	Units	Alarm List	Remarks
YI-103B	Station Sewage Pump #3	Worcester Road Sewer Pumping Station	Pump #3 Run Status	DI	--	RTU-1	--	--	--	FALSE	--
YI-103C	Station Sewage Pump #3	Worcester Road Sewer Pumping Station	Pump #3 in Bypass	DI	--	RTU-1	--	--	--	FALSE	--
MSH-103	Station Sewage Pump #3	Worcester Road Sewer Pumping Station	Pump #3 Seal Chamber Leak	DI	--	RTU-1	--	--	--	TRUE	--
TAH-103	Station Sewage Pump #3	Worcester Road Sewer Pumping Station	Pump #3 High Motor Temperature	DI	--	RTU-1	--	--	--	TRUE	--
YA-103A	Station Sewage Pump #3	Worcester Road Sewer Pumping Station	Pump #3 VFD Alarm	DI	--	RTU-1	--	--	--	TRUE	--
YA-103B	Station Sewage Pump #3	Worcester Road Sewer Pumping Station	Pump #3 Soft Starter Alarm	DI	--	RTU-1	--	--	--	TRUE	--
OS-103	Station Sewage Pump #3	Worcester Road Sewer Pumping Station	Pump #3 Emergency Stop	DI	--	RTU-1	--	--	--	TRUE	--
ZSA-103	Station Sewage Pump #3	Worcester Road Sewer Pumping Station	Pump #3 Check Valve Failure	DI	--	RTU-1	--	--	--	TRUE	--
PSA-103	Station Sewage Pump #3	Worcester Road Sewer Pumping Station	Pump #3 Water Seal Failure	DI	--	RTU-1	--	--	--	TRUE	--
SI-103	Station Sewage Pump #3	Worcester Road Sewer Pumping Station	Pump #3 VFD Speed	AI	4-20 mA DC	RTU-1	0	100	%	FALSE	--
YS-103	Station Sewage Pump #3	Worcester Road Sewer Pumping Station	Pump #3 Start/Stop	DO	--	RTU-1	--	--	--	FALSE	--
SC-103	Station Sewage Pump #3	Worcester Road Sewer Pumping Station	Pump #3 VFD Speed Command	AO	4-20 mA DC	RTU-1	30	100	%	FALSE	--
FIT-105	Station Effluent Flow	Worcester Road Sewer Pumping Station Effluent Line	Station Effluent Flow Rate	AI	4-20 mA DC	RTU-1	0	xx	GPM	TRUE	FAHH, FAH, FAL, FALL
LIT-110	Bioxide Tank#1 Level	Worcester Road Sewer Pumping Station	Bioxide Tank #1 Level	AI	4-20 mA DC	RTU-1	0	20	Feet	TRUE	LAHH, LAH, LAL, LALL
LIT-111	Bioxide Tank#2 Level	Worcester Road Sewer Pumping Station	Bioxide Tank #2 Level	AI	4-20 mA DC	RTU-1	0	20	Feet	TRUE	LAHH, LAH, LAL, LALL
LSH-112	Bioxide Tank Leak	Worcester Road Sewer Pumping Station	Bioxide Tank Leak	DI	--	RTU-1	--	--	--	TRUE	--
FSH-113	Eyewash/Shower	Worcester Road Sewer Pumping Station	Eyewash Shower Activated	DI	--	RTU-1	--	--	--	TRUE	--

IO AND ALARM LIST

IO Tag No	Service	Location	IO Description	IO Type	IO Signal Range	CP Termination	LRL	URL	Units	Alarm List	Remarks
YI-115	Bioxide Pump #1	Worcester Road Sewer Pumping Station	Bioxide Pump #1 Run Status	DI	--	RTU-1	--	--	--	FALSE	--
YA-115	Bioxide Pump #1	Worcester Road Sewer Pumping Station	Bioxide Pump #1 Alarm	DI	--	RTU-1	--	--	--	FALSE	--
YS-115	Bioxide Pump #1	Worcester Road Sewer Pumping Station	Bioxide Pump #1 Start/Stop	DO	--	RTU-1	--	--	--	FALSE	--
SI-115	Bioxide Pump #1	Worcester Road Sewer Pumping Station	Bioxide Pump #1 Pump Speed Feedback	AI	4-20 mA DC	RTU-1	0	100	%	FALSE	--
SC-115	Bioxide Pump #1	Worcester Road Sewer Pumping Station	Bioxide Pump #1 Pump Speed Command	AO	4-20 mA DC	RTU-1	0	100	%	FALSE	--
YI-116	Bioxide Pump #2	Worcester Road Sewer Pumping Station	Bioxide Pump #2 Run Status	DI	--	RTU-1	--	--	--	FALSE	--
YA-116	Bioxide Pump #2	Worcester Road Sewer Pumping Station	Bioxide Pump #2 Alarm	DI	--	RTU-1	--	--	--	FALSE	--
YS-116	Bioxide Pump #2	Worcester Road Sewer Pumping Station	Bioxide Pump #2 Start/Stop	DO	--	RTU-1	--	--	--	FALSE	--
SI-116	Bioxide Pump #2	Worcester Road Sewer Pumping Station	Bioxide Pump #2 Pump Speed Feedback	AI	4-20 mA DC	RTU-1	0	100	%	FALSE	--
SC-116	Bioxide Pump #2	Worcester Road Sewer Pumping Station	Bioxide Pump #2 Pump Speed Command	AO	4-20 mA DC	RTU-1	0	100	%	FALSE	--
YI-117	Bioxide Pump #3	Worcester Road Sewer Pumping Station	Bioxide Pump #3 Run Status	DI	--	RTU-1	--	--	--	FALSE	--
YA-117	Bioxide Pump #3	Worcester Road Sewer Pumping Station	Bioxide Pump #3 Alarm	DI	--	RTU-1	--	--	--	FALSE	--
YS-117	Bioxide Pump #3	Worcester Road Sewer Pumping Station	Bioxide Pump #3 Start/Stop	DO	--	RTU-1	--	--	--	FALSE	--

IO AND ALARM LIST

IO Tag No	Service	Location	IO Description	IO Type	IO Signal Range	CP Termination	LRL	URL	Units	Alarm List	Remarks
SI-117	Bioxide Pump #3	Worcester Road Sewer Pumping Station	Bioxide Pump #3 Pump Speed Feedback	AI	4-20 mA DC	RTU-1	0	100	%	FALSE	--
SC-117	Bioxide Pump #3	Worcester Road Sewer Pumping Station	Bioxide Pump #3 Pump Speed Command	AO	4-20 mA DC	RTU-1	0	100	%	FALSE	--
YA-120A	Generator	Worcester Road Sewer Pumping Station	Generator Failure	DI		RTU-1	--	--	--	TRUE	--
YA-120B	Generator	Worcester Road Sewer Pumping Station	Generator Alarm	DI		RTU-1	--	--	--	TRUE	--
YA-120C	Generator	Worcester Road Sewer Pumping Station	Generator Low Fuel Level	DI		RTU-1	--	--	--	TRUE	--
YA-120D	Generator	Worcester Road Sewer Pumping Station	Generator Fuel Tank Leak	DI		RTU-1	--	--	--	TRUE	--
YI-120A	Generator	Worcester Road Sewer Pumping Station	Generator On	DI		RTU-1	--	--	--	FALSE	--
YI-120B	Generator	Worcester Road Sewer Pumping Station	Generator Not in Auto	DI		RTU-1	--	--	--	FALSE	--
YI-121A	Transfer Switch	Worcester Road Sewer Pumping Station	Normal Position	DI		RTU-1	--	--	--	FALSE	--
YI-121B	Transfer Switch	Worcester Road Sewer Pumping Station	Emergency Position	DI		RTU-1	--	--	--	FALSE	--
YI-121C	Transfer Switch	Worcester Road Sewer Pumping Station	Los of Utility Power	DI		RTU-1	--	--	--	TRUE	--
JAL-125A	SCADA RTU	Worcester Road Sewer Pumping Station SCADA RTU	120VAC Primary Power Failure	DI	--	RTU-1	--	--	--	TRUE	--
JAL-125B	SCADA RTU	Worcester Road Sewer Pumping Station SCADA RTU	120VAC Secondary Power Failure	DI	--	RTU-1	--	--	--	TRUE	--
JAL-127	SCADA RTU	Worcester Road Sewer Pumping Station SCADA RTU	UPS Ready	DI	--	RTU-1	--	--	--	FALSE	--
JAL-127A	SCADA RTU	Worcester Road Sewer Pumping Station SCADA RTU	UPS Replace Batteries	DI	--	RTU-1	--	--	--	TRUE	--
JAL-127B	SCADA RTU	Worcester Road Sewer Pumping Station SCADA RTU	UPS Buffering	DI	--	RTU-1	--	--	--	TRUE	--

IO AND ALARM LIST

IO Tag No	Service	Location	IO Description	IO Type	IO Signal Range	CP Termination	LRL	URL	Units	Alarm List	Remarks
JAL-128	SCADA RTU	Worcester Road Sewer Pumping Station SCADA RTU	120V Main Surge Protector Fault	DI	--	RTU-1	--	--	--	TRUE	--
ZS-130A	Station Building Intrusion	Worcester Road Sewer Pumping Station Building	Station Intrusion	DI		RTU-1	--	--	--	TRUE	--
ZS-130B	Generator Intrusion	Worcester Road Sewer Pumping Station Generator	Generator Enclosure Intrusion	DI		RTU-1	--	--	--	TRUE	--
ZS-130C	Wet Well Intrusion	Worcester Road Sewer Pumping Station Wet Well	Wet Well Intrusion	DI		RTU-1	--	--	--	TRUE	--
TSH-130D	Station Upper Level Fire	Worcester Road Sewer Pumping Station Lower Level	Station Lower Level Fire	DI		RTU-1	--	--	--	TRUE	--
TSH-130E	Station Upper Level Fire	Worcester Road Sewer Pumping Station Lower Level	Station Lower Level Fire	DI		RTU-1	--	--	--	TRUE	--
YA-130F	Station Help Call	Worcester Road Sewer Pumping Station	Station Help Call	DI		RTU-1	--	--	--	TRUE	--
LSH-135	Station Flood	Worcester Road Sewer Pumping Station Lower Level	Station Flood	DI	--	RTU-1	--	--	--	TRUE	--
TIT-136A	Station Upper Level Temperature	Worcester Road Sewer Pumping Station	Station Temperature	AI	4-20 mA DC	RTU-1	0	100	F	TRUE	TAH, TAL
TIT-136B	Station Lower Level Temperature	Worcester Road Sewer Pumping Station	Station Temperature	AI	4-20 mA DC	RTU-1	0	100	F	TRUE	TAH, TAL
YI-140	HVAC RTU	HVAC RTU	HVAC RTU Running	DI		RTU-1	--	--	--	FALSE	--
YA-140	HVAC RTU	HVAC RTU	HVAC RTU Alarm	DI		RTU-1	--	--	--	TRUE	--

Notes:

- The IO and Alarm List contains a list of the physical IO points. Refer to the Loop Descriptions in this Section for additional IO points. For example, elapsed time meters (KQI-xxx), flow totalizers (FQI-xxx), motor state disagreement alarms (YA-xxx), software-based selector switches, start/stop or reset pushbuttons (HS-xxx), software-based timers (KC-xxx), level set points (LS-xxx), etc.
- The IO point has one or more alarm points when “TRUE” appears in the “Alarm List” column. If no ISA identification letters appear in the “Alarm Remarks” column, then the alarm tag is the same as the tag in the “IO Tag No” column. When multiple sets of ISA identification letters appear in the “Alarm Remarks” column, create an alarm point for each set of ISA identification letters. Refer to the

examples below. IO points with multiple alarm points are typical for *IT or *T ISA identification letters in the “IO Tag No” column, where * = first letter(s) of the set of ISA identification letters. Refer to the “Alarm Remarks” column for the specific alarms.

*AHH = * alarm high high. Initially set at LRL + 90% of span rising, adjustable
*AH = * alarm high. Initially set at LRL + 80% of span rising, adjustable
*AL = * alarm low. Initially set at LRL + 20% of span falling, adjustable
*ALL = * alarm low low. Initially set at LRL + 10% of span falling, adjustable
d*/dt = high rate of change alarm. Initially set at 5% of span/second, adjustable
*DAH = set point deviation alarm. Initially set at 5% of set point, adjustable

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 17320

CONTROL SYSTEM EQUIPMENT PANELS AND RACKS

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. Provide all wiring, labor, tools, materials, and equipment to furnish, install, and test control panels and enclosures in accordance with this Section, applicable reference standards listed in Section 01090 Reference Standards, and shop drawing level Drawings.
2. Work by Engineer (Woodard & Curran)
 - a. PLC, OIT and HMI Programming
 - b. Integration of radio-based SCADA telemetry system

B. Related Requirements

1. Section 17300 – Instrumentation and Controls
2. Division 16 Electrical – Specifications for electrical wiring standards and practices

1.02 PRICE AND PAYMENT PROCEDURES

- A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

A. Reference Standards

1. American National Standards Institute (ANSI)
2. ASTM International (ASTM)
3. FM Global (FM)
4. International Society of Automation (ISA)
 - a. ISA-RP60.3 Recommended Practice
5. National Electrical Code (NEC)
6. National Electrical Manufacturers Association (NEMA)
7. National Fire Protection Association (NFPA)

- a. NFPA 70
 - b. NFPA 79 Electrical Standard for Industrial Machinery
- 8. Occupational Safety and Health Administration (OSHA)
- 9. Underwriters Laboratories (UL)
 - a. Standard 508A - Standard for Industrial Control Panels
- B. Definitions
 - 1. PLC – Programmable Logic Controller
 - 2. RIO – Remote Input/Output Rack
 - 3. OIT – Operator Interface Terminal
 - 4. HMI – Human Machine Interface
 - 5. RTU – Remote Terminal Unit
 - 6. I/O – Input/Output
 - 7. SCADA – Supervisory Control and Data Acquisition
 - 8. Modules – devices that plug into a chassis or connect to an adjacent module and are keyed to allow installation in only one direction

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.
 - 1. Coordinate equipment, and material delivery with Project schedule. Notify Engineer if delivery schedule of equipment, instruments, or material affects Project schedule. Include documentation from equipment Supplier indicating revised delivery schedule and reason for change.

1.05 SUBMITTALS

- A. Submit in accordance with Division 01 General Requirements.
- B. Product Data: as listed below unless letter regarding shop drawing level control panel Drawings is submitted per Paragraph 1.05.C.1. below.
 - 1. Bill of materials (BOM) for each control panel, including panel tag name or number and component description, quantity, manufacturer name and model number for each component used in fabrication. BOM: keyed to easily correlate components shown in bill of materials with components shown on control panel equipment layout Drawings.
 - 2. Manufacturer’s literature for each component identified on BOM. Clearly designate part number with highlights or arrows.

3. Equipment layout drawings for each control panel
 4. Panel communication diagrams for each control panel
 5. Power wiring diagrams for each control panel
 6. Programmable logic controllers (PLC) input/output (I/O) wiring diagrams, on a module-by-module basis
- C. Shop Drawings
1. Contractor may provide letter with copy of fabrication drawings confirming control panel fabricator will fabricate control panels as specified on shop drawing level control panel Drawings in lieu of Shop Drawings.
- D. Closeout and Maintenance Material Submittals: per Division 01 General Requirements.
1. As-Built Drawings
 - a. After fabrication of control panels and factory acceptance testing is complete, panel shop shall provide Drawings of control panels, representing as-built conditions. Submit panel Drawings in AutoCAD DWG and Adobe PDF file formats, on USB drive or DVD-R media.
 - b. Submit with panels at delivery.
 - c. Contractor may provide legible red-line markups of shop level Drawings from panel shop if used in lieu of Shop Drawings.

1.06 QUALITY ASSURANCE

- A. Provide in accordance with Division 01 General Requirements.
- B. Qualifications: per Division 01 General Requirements and as follows.
1. Control panel fabricator/panel shop fabrication facility: UL 508A certified, in operation at least 5 years, regularly engaged in furnishing, installing, and wiring similar equipment for use in water and wastewater treatment facilities, and minimum of 3 projects of similar scope in past 5 years.
 2. Surge protection: provided by manufacturer with minimum of 5 years' experience in production of this equipment.
- C. Panel Shop
1. Following control panel fabrication, apply power to each panel to ensure panels are wired correctly and devices contained within panels power up correctly. Provide written confirmation that a power up test was completed.

2. Complete point-to-point wiring checkout for wiring contained in control panels and correct any errors or omissions found. Provide written confirmation that checkout was completed.
3. Provide Engineer 5 days' notice of completion of control panel fabrication and have control panels available in their facility for Factory Acceptance Test by Engineer or System Integrator. Control panels may not be shipped prior to execution of Factory Acceptance Test unless indicated in writing by Engineer.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Provide in accordance with Division 01 General Requirements and Section 13400.

1.08 SITE CONDITIONS

- A. Existing Conditions: per Division 01 General Requirements.

PART 2 – PRODUCTS

2.01 MATERIALS

- A. Procurement of materials and manufacture of control panels shall not begin until related submittals have been reviewed and approved by the Engineer.

2.02 CONTROL PANEL COMPONENTS

A. PROGRAMMABLE LOGIC CONTROLLERS

1. PLC hardware and programming software: by same manufacturer.
2. Minimum PLC input/output (I/O) requirements as indicated on Drawings. Provide additional 20 percent active spare I/O wired to terminal blocks; relay outputs, wired to interposing relays.
3. Provide PLC rack or mounting space to accommodate additional 20 percent minimum spare slots for future expansion.
4. Provide microprocessor based PLC devices with power supplies, processors, process input and output modules, communication cards and chassis, mounted in control panel.
5. Size power supplies to accommodate analog signals, including spares, and card's entire I/O capacity.
6. Provide PLC capable of stand-alone operation in the event of SCADA network or SCADA computer failure.
7. Provide UL listed PLC system using modular, field expandable design.

8. Module design shall prohibit upside down insertion or connection of modules, and be compatible with processor type specified.
9. Operate programmable controller hardware at ambient temperature of 32-140 degrees F. Ambient temperature rating for storage: minus 40-185 degrees F.
10. Provide PLC hardware to function continuously in relative humidity range of 5-95 percent, non-condensing.
11. Provide PLC system designed and tested to operate in the high electrical noise environment of an industrial plant.
12. Module-expandable PLCs and associated modules
 - a. Series processor acceptable level of quality: equivalent to Allen-Bradley CompactLogix 5380 series (5069-L306ER).
 - b. Discrete input modules acceptable level of quality: equivalent to Allen-Bradley 5069-IB16.
 - c. Discrete output modules acceptable level of quality: equivalent to Allen-Bradley 5069-OW16.
 - d. Analog input modules acceptable level of quality: equivalent to Allen-Bradley 5069-IF8.
 - e. Analog output modules acceptable level of quality: equivalent to Allen-Bradley 5069-OF8.
 - f. Memory module acceptable level of quality: equivalent to Allen-Bradley 1784-SD1 and 1784-SD2.

B. OPERATOR INTERFACE TERMINALS

1. Operator interface terminal: color graphic display connecting directly to PLC communication port or a communication module, allowing viewing and changing of PLC parameters, rated NEMA 4/4X, powered by 24VDC with integrated real-time clock and battery backup.
2. Minimum OIT resolution of 1024 by 768 XGA graphics with 16-bit color graphics, touch screen operation. Minimum display size: 15" inch with display area of 11.97" inches by 8.98" inches.
3. Provide OIT with 82MB internal project memory with compact flash port. Provide 1 GB compact flash card for each operator terminal.
4. Provide OIT with real-time trending of process variables.
5. Provide OIT with active and historical alarm screens with ability to acknowledge and clear.
6. Provide OIT with ability to display a selectable screen based on specific alarm bits.

7. Provide all communication modules and cables for OIT - PLC communications. PLC interface: Ethernet/IP.
8. Provide and coordinate communications protocol drivers to establish reliable communications between PLC and OIT.
9. Provide OIT programming & configuration cables.
10. Provide OIT with licensed copy of programming software.
11. OIT acceptable level of quality: equivalent to Automation Direct 15-inch Color active-matrix TFT Touch Panel, part number EA9-T15CL-R.

C. Control Panel Components and Recommended Manufacturers

Control Panel Components	Expected level of quality: equivalent to listed manufacturers	Comments
Enclosures	Hoffman Hammond Saginaw APX	Suitable for use in environments where located per (NEMA, NFPA, etc.)
Wireway	Panduit Hoffman	
DIN Rail	Allen Bradley Phoenix Contact	
Radio Equipment	Calamp Viper SC200	Match existing Site standards.
Terminal Blocks	Allen Bradley Phoenix Contact Entrelec	Utilize 2-tier terminal blocks wherever possible to conserve panel space.
Terminal Block Fuse Holders	Allen Bradley Phoenix Contact Entrelec	Specify fuse holders with blown fuse indicators.
Circuit Breakers	Square D Allen Bradley	
120VAC Surge Suppressors	Phoenix Contact Square D	
Analog Surge Suppressors	Phoenix Contact Citel	
Media Converters	N-Tron B&B Electronics L-Com	Provide with DIN rail mount feature

Control Panel Components	Expected level of quality: equivalent to listed manufacturers	Comments
Fuses	Bussman Ferraz Shawmut	All glass fuses in control panels shall be fast acting style. Motor circuit protection and/or inductive load fuses shall be time delay style.
Control Relays	Allen Bradley Square D Omron	Include all required bases, hardware, etc.
Power Supplies	Sola Phoenix Contact Allen Bradley	Provide with power supplies sized as required for equipment contained within the enclosures and to supply field equipment connected to the enclosure.
Intrinsic Safety Barriers	Pepperl & Fuchs MTL Phoenix Contact	Discrete barriers shall be 2-channel barriers. Analog barriers shall be 2-wire barriers.
Ethernet Switches (Unmanaged)	Allen Bradley N-Tron Moxa	Switches shall be provided with direct-wired low voltage power source within the enclosure.
Ethernet Switches (Managed)	Allen Bradley N-Tron Moxa	All switches comprising the ring topology throughout the facility shall be provided from the same manufacturer.
Fiber Patch Panels	L-Com B&B Electronics	Provide with panel mount patch panels for incoming fiber optic cables as required
Emergency Power System	Allen Bradley Phoenix Contact Sola	Include uninterruptible power supply (UPS) in each control panel sized to furnish with at least 10 minutes of emergency power.
Panel Heaters	Hammond Hoffman	Provide with panel heaters for outside control panels where temperature is a concern for electronic components.
Receptacles	Pass & Seymour Hubbel Leviton	Provide with receptacle for UPS and convenience receptacle in each PLC control panel.
Pilot/Status Lights (Push to test)	Allen Bradley General Electric Square D	Color code as follows: Red-Fault, Green-Run
HOR, On/Off, L/R switches and push buttons	Allen Bradley General Electric Square D	Refer to Division 16. Furnish switches and push buttons with matching nameplate

2.03 SOURCE QUALITY CONTROL

- A. Provide in accordance with Division 01 General Requirements.

PART 3 – EXECUTION

3.01 CONTROL PANEL FABRICATION

- A. General
 - 1. Fabricate panels per Shop level drawings.
 - 2. Control panels shall include PLC, required I/O modules with chassis, if applicable, power supply, cables, and all appurtenances. Enclosures shall include switches, lights, annunciators and all appurtenances. Furnish panels and materials from one Supplier.
 - 3. Provide electronic equipment utilizing printed circuitry and epoxy or equal coating to prevent contamination by dust, moisture, and fungus. Solid-state components: rated to provide reliable performance over ambient atmosphere fluctuations between 0 – 140 degrees F and 0 – 95 percent relative humidity, non-condensing. Field mounted equipment and system components: designed for installation in dusty, humid, and slightly corrosive service conditions.
 - 4. Equipment installed in a hazardous area shall meet Class, Group, and Division to comply with the NFPA 70.
 - 5. Provide heavy duty equipment, cabinets, and devices designed for continuous industrial service.
 - 6. Fabrication requirements of control panels, enclosures, consoles, and cabinets.
 - a. Size control panel enclosures to provide at least 20 percent spare space for future expansion.
 - b. Provide PLC hardware to accommodate minimum 20 percent spare of each I/O type used in panel, wired to terminals and interposing relays during fabrication process.
 - c. Provide control panel assemblies in compliance with UL 508A Standards.
- B. Wiring
 - 1. Interconnecting wiring: stranded and have 600-volt insulation.
 - 2. Power distribution wiring on line side of fuses in accordance with Division 16.

3. Power and low voltage direct current (DC) wiring systems: routed in separate wireways. Crossing of power distribution wiring and control wiring: at right angles. Different system wires routed parallel to each other: separated by at least 6 inches. Different wiring systems shall terminate on separate terminal blocks. Wiring troughs may not be filled to more than 60 percent visible fill.
4. All wiring shall terminate onto single-or-double tier terminal blocks, where each terminal is sequentially numbered with a unique identifier. Direct interlock wiring between equipment is not allowed. Control panel: fabricated with minimum 20 percent spare terminals. Terminal blocks: arranged in vertical rows and separated into groups; power, alternating current (AC) control, DC signal. Terminal blocks: compression screw type. Spring-clamp style terminals will not be accepted.
 - a. Discrete inputs (DI) and discrete outputs (DO) shall have 2 terminals per point with adjacent terminal assignments. Active and spare points: wired to terminal blocks.
 - b. Analog inputs (AI) and analog outputs (AO) shall have a minimum of 3 terminals per shielded pair. Provide 3 terminals for direct connection of powered, 4-wire loops. Provide 4 terminals for direct connection of loop powered, 2-wire loops. Provide 5 terminals for connection of analog loops incorporating a local indicator or recorder. One terminal is for shielded ground connections for cable pairs. Ground the shielded signal cable at the PLC cabinet. Wire active and spare points to terminal blocks.
 - c. Wire and tube markers in accordance with Division 16.
 - d. Only 1 side of a terminal block row shall be used for internal wiring. Field wiring side of terminal shall not be within 6 inches of side panel or adjacent terminal, or within 8-inches of bottom of panel.
 - e. Locate terminals for field wiring to reduce amount of routing through wireway to carry wiring to termination point.
5. Provide wiring, internal to panel and field wiring, with service loop to allow for future adjustment of termination point. Service loop: no more than 4-5 inches, stored in associated wireway.
6. Identify live circuit wiring, independent of the panel's normal circuit breaker protection.
7. All wiring shall be clearly tagged and color-coded in accordance with NEC. All tag numbers and color-coding shall correspond to panel wiring diagrams prepared by Engineer. All power wiring, control wiring, grounding, and DC wiring shall utilize different color insulation for each wiring system used. Utilize the following color coding scheme.
 - a. Incoming 120 VAC Hot – Black

- b. 120 VAC Hot Wiring (control circuit wires downstream of panel circuit breaker) – Red
 - c. 120 VAC Neutral – White
 - d. Ground – Green with yellow stripe
 - e. DC Wiring – Blue
 - f. DC Common – White with blue stripe
 - g. Intrinsically Safe Wiring - Light Blue
 - h. Foreign Voltage – Yellow
- C. Control Panel Loss of Power
- 1. Each control panel containing a PLC shall have an input configured to alarm the operators upon loss of main control panel power. Display alarm on SCADA nodes to alert operators that attention is required.
 - 2. Provide control panels containing a backup PLC for wetwell level control with an input configured on the main PLC to alarm operators upon loss of backup PLC power.
- D. Control Panel Overcurrent Protection
- 1. Overcurrent protection devices: properly sized to protect associated devices and loads.
 - 2. Circuit breakers: sized to protect associated equipment and provide necessary power to operate.
 - 3. Fuses
 - a. Glass fuses not associated with motor circuit protection or inductive loads: specified as fast-acting style. Fuses associated with motor circuit protection or inductive loads: specified as time delay style.
- E. Lightning/Surge Suppression
- 1. Provide to protect control panel and associated equipment from surges on incoming power circuits, or those induced by lightning strikes and propagated along signal or power lines connected to control panels. Surge protection: sized properly for intended purpose.
 - 2. 120 VAC Surge Suppression
 - a. Provide incoming 120 VAC power source for control panel with surge suppression located in the control panel. Provide surge suppressors with auxiliary contact, connected to PLC to indicate surge suppressor failure. If there are multiple circuits within the same control panel, provide each incoming 120 VAC power source with surge suppression.

3. Analog Signal Surge Suppression
 - a. Supply analog signals connected to equipment or instrumentation located outside the building where the control panel is installed with DIN rail mounted surge suppression in control panel. Provide surge protection at both ends of signal cable and mount surge protection as close to equipment, instrument, or termination point as possible. Provide minimum of 10 kA surge current suppression.
4. Telephone Line and Ethernet Surge Suppression
 - a. Provide copper-based telephone lines and Ethernet cabling connected to control panel that leaves the building that houses the control panel with surge suppression in the control panel. Provide surge protection at both ends of telephone or Ethernet cabling and mount surge protection as close to termination point as possible.
- F. Selector Switches, Pushbuttons and Pilot Lights
 1. Provide for the enclosures in accordance with Division 16.
- G. Uninterruptible Power Supplies
 1. Provide control panel containing PLC with an uninterruptible power supply (UPS) sized to provide minimum of 10 minutes of power in event of main control power loss. Provide at minimum, UPS with relay contact outputs, connected to the PLC to indicate UPS fault and UPS low battery conditions.
- H. Ethernet Switches
 1. Configure ethernet switches to accept number of connections shown on Drawings.
 2. Provide ethernet switches with minimum of 20 percent spare RJ-45 ports available for future expansion.
- I. Seal Fail and Motor Temperature Relays
 1. Pumps, mixers and other equipment equipped with proprietary seal fail and motor temperature relays, require relays to be mounted in the SCADA control panel. Seal fail and motor over temperature alarm contacts: connected to PLC as discrete inputs.
- J. Intrinsic Safety Barrier Panels
 1. Mount intrinsic safety barriers required for interfacing with equipment and instruments located in a classified area, in panel separate from control panels.
 2. Panels housing intrinsic safety barriers: laid out to facilitate separation of hazardous and non-hazardous wiring. Wireway containing hazardous area wiring: clearly indicated.

K. Equipment Mounting/Arrangement

1. Mount components in a manner that permits servicing, adjustment, testing and removal without disconnecting, moving or removing any other component. Mount components on inside of panels on removable plates, not directly to enclosure. Mounting: rigid and stable unless shock mounting is required by manufacturer to protect from vibration. Identify components with plastic or metal engraved tags attached with drive pins adjacent to each component, identifying the component in accordance with the Drawings and Specifications.
2. Install exterior panel mounted equipment with suitable gaskets, faceplates, and other measures required to maintain NEMA rating of panel.
3. Provide minimum of 1-1/2 inches between panel wireway and terminal blocks for easy access to wiring.
4. Maintain manufacturer recommended spacing around panel-mounted equipment.
5. ISA-RP60.3 Recommended Practice: used as a guide in layout and arrangement of panels and panel mounted components.

L. Nameplates

1. Furnish panels and panel devices with nameplates identifying panel and individual devices with the following.
 - a. Device tag number: as shown on Drawings.
 - b. Functional description
 - c. Functional control description
2. Furnish 3/32-inch thick, black and white, Lamacoid nameplates with engraved inscriptions, unless escutcheon plates are specified or noted on Drawings. Letters: black against a white background. Edges of nameplates: beveled and smooth. Affix to panels using #4-40 threaded stainless steel button head hex screws.

3.02 INSTALLATION AND MOUNTING

- A. Location of control panel shown on Drawings is approximate. Obtain information relevant to process control placement Work in the field. Exact location: approved by Owner or Engineer during construction. In case of interference with other Work, proceed as directed by Engineer.

3.03 MAINTENANCE AND SPARE PARTS

- A. Extra Materials and Spare Parts: as specified below. Make interchangeable with and of same material and workmanship as corresponding original parts.

- B. Control Panel Spares: one of each type of the following.
 - 1. Surge protector
 - 2. Power supply
 - 3. Radio Modem (IP router for licensed spectrum radio)
 - 4. Fuses (minimum 10 percent spares of each type)
- C. Programmable Logic Controller Spares: one of each type of the following
 - 1. PLC processor
 - 2. I/O module
 - 3. Memory module

3.04 FIELD QUALITY CONTROL

- A. Provide in accordance with Division 01 General Requirements.

3.05 STARTUP & COMMISSIONING

- A. Provide in accordance with Division 01 General Requirements.
- B. Power up SCADA Panel upon delivery to Owner.
- C. Power up control panels upon installation. Test field wiring for proper termination. Analog signals: simulated for a full scale 4-20mA test.
- D. Provide testing of SCADA system with Integrator after installation of control panels and instruments, and termination of field wiring to panels is complete. Start up and testing: witnessed by Owner.

3.06 CLOSEOUT ACTIVITIES

- A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

APPENDIX A: Worcester Road Sewer Pump Station-Hazardous Materials Survey

THE REMAINDER OF THIS PAGE HAS BEEN LEFT BLANK INTENTIONALLY

APPENDIX B: City of Framingham Construction Standards

THE REMAINDER OF THIS PAGE HAS BEEN LEFT BLANK INTENTIONALL

APPENDIX C: Framingham Conservation Order of Conditions

THE REMAINDER OF THIS PAGE HAS BEEN LEFT BLANK INTENTIONALLY

APPENDIX D: SCADA Panel Drawings

THE REMAINDER OF THIS PAGE HAS BEEN LEFT BLANK INTENTIONALLY

APPENDIX E: Geotechnical Report and Boring Logs

THE REMAINDER OF THIS PAGE HAS BEEN LEFT BLANK INTENTIONALLY

APPENDIX F: City of Framingham Noise Ordinance

THE REMAINDER OF THIS PAGE HAS BEEN LEFT BLANK INTENTIONALLY

APPENDIX G: Risk Based Cleanup Plan

THE REMAINDER OF THIS PAGE HAS BEEN LEFT BLANK INTENTIONALLY

APPENDIX H: MassDOT Access Permit

Massachusetts Department of Transportation Application for Permit to Access State Highway

THE REMAINDER OF THIS PAGE HAS BEEN LEFT BLANK INTENTIONALLY