PROJECT MANUAL

New DPW Facility

180 Turnpike Road Turners Falls

Massachusetts

PREPARED FOR

Awarding Authority
Town of Montague
Montague Town Hall, One Avenue A
Turners Falls, Massachusetts 01376

Prime Designer
HELENE KARL Architects, Inc.
61 Skyfields Drive
Groton, MA, 01450
Phone: (978) 449-0470
Fax: (978) 449-0469

DATE: 15 May 2019

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Section 00.01.05
LIST OF CONSULTANTS

New DPW Facility

AWARDING AUTHORITY
Town of Montague
Montague Town Hall, One Avenue A
Turners Falls, MASSACHUSETTS 01376
413-863-3200

PRIME DESIGNER
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61 Skyfields Drive
Groton, MA 01450
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Civil Engineer
SMMA
400 Westminster Street
Providence, RI 02903
Phone: (401) 519-0069

Electrical Engineer
John Murphy, Jr. Electrical
379 Liberty Street, 204
Rockland, MA 02370
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Mechanical Engineer
Seaman Engineering Corp.
22 West Street, Unit C
Millbury, MA 01527
Phone: (508) 865-1400
Fax: (508) 865-1401

Structural Engineer
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Cambridge, MA 02138
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Fax: (617) 354-5758

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The **Town of Montague**, the Awarding Authority, invites sealed bids from General Contractors for the New DPW Facility in Turners Falls Massachusetts, in accordance with the documents prepared by HELENE KARL Architects, Inc..

The Project consists of: Site work, construction of a new 28,850 SF pre-engineered building that accommodates administrative space, vehicle repair bays, vehicle storage bays, truck wash, shops and storage. In addition, the work includes construction of a new 50' x 90' fabric salt storage structure.

In general, the Work will include site work and utilities (soils, water, sewer, drains, infiltration system, paving, landscaping); new concrete foundations and pre-engineered steel superstructure; masonry veneer and metal panel envelope; fiberglass windows; interior finishes (ceramic tile, epoxy flooring, suspended ceilings, millwork, painting, doors & hardware, toilet accessories, signage); 10-ton bridge crane; fire protection and alarm systems; plumbing; HVAC (radiant floor heat), tele/data and electrical.

NOTE: ALL QUESTIONS MUST BE SUBMITTED BY 5:00 p.m. on 5/30/19 to hka@npv.com or faxed to 978-449-0469.

The work is estimated to cost $8,500,000**.**

Bids are subject to M.G.L. c.149 §44A-J & to minimum wage rates as required by M.G.L. c.l49 §§26 to 27H inclusive.

THIS PROJECT IS BEING ELECTRONICALLY BID AND HARD COPY BIDS WILL NOT BE ACCEPTED. Please review the instructions in the bid documents on how to register as an electronic bidder. The bids are to be prepared and submitted at www.biddocsonline.com . Tutorials and instructions on how to complete the electronic bid documents are available online (click on the "Tutorial" tab at the bottom footer).

General bidders must be certified by the Division of Capital Asset Management and Maintenance (DCAMM) in the following category of work, General Building Construction**,** and must submit a current DCAMM Certificate of Eligibility and signed DCAMM Prime/General Contractor Update Statement.

General Bids will be received until **2:00 PM** on **Thursday, 20 June 2019** and publicly opened online, forthwith.

Filed Sub-bids for the trades listed below will be received until **2:00 PM** on **Thursday, 6 June 2019** and publicly opened online, forthwith.

Filed sub-bidders must be DCAMM certified for the trades listed below and bidders must include a current DCAMM Sub-Bidder Certificate of Eligibility and a signed DCAMM Sub-Bidder's Update Statement.

SUBTRADES

Section 04 20 00 - Masonry Work
Section 05 01 00 - Miscellaneous Metals
Section 09 90 00 - Painting
Section 21 00 00 - Fire Protection Sprinkler Systems
Section 22 00 00 - Plumbing
Section 23 00 00 - HVAC
Section 26 00 00 - Electrical Work

All Bids should be submitted online at www.biddocsonline.com and received no later than the date and time specified above.

General bids and sub-bids shall be accompanied by a bid deposit that is not less than five (5%) of the greatest possible bid amount (considering all alternates), and made payable to the **Town of Montague**.

Bid Forms and Contract Documents will be available for pick-up at www.biddocsonline.com (may be viewed electronically and hardcopy requested) or at Nashoba Blue, Inc. at 433 Main Street, Hudson, MA 01749 (978-568-1167).

There is a plan deposit of $150.00 per set (maximum of 2 sets) payable to BidDocs ONLINE Inc.

Plan deposits may be electronically paid or by check. This deposit will be refunded for up to two sets for general bidders and for one set for sub-bidders upon return of the sets in good condition within thirty (30) days of receipt of general bids. Otherwise the deposit shall be the property of the Awarding Authority.

Additional sets may be purchased for $150.00.

Bidders requesting Contract Documents to be mailed to them shall include a separate check for $ **40.00** per set for UPS Ground (or $65.00 per set for UPS overnight), non-refundable, payable to the BidDocs ONLINE Inc., to cover mail handling costs.

PRE-BID CONFERENCE / SITE VISIT:
Date and Time: Thursday, 23 May 2019 at 10:00 AM
Address: One Avenue A
1st Floor Conference Room, Turners Falls, MA

Instructions: Bidders may visit the site on their own.
NOTE: ALL QUESTIONS MUST BE SUBMITTED BY 5:00 p.m on 5/30/19 to hka@npv.com or faxed to 978-449-0469.

The Contract Documents may be seen, but not removed at:

Town of Montague
Montague Town Hall, One Avenue A
Turners Falls, MA 01376
413-863-3200

Nashoba Blue Inc.
433 Main Street
Hudson, MA 01749

978-568-1167

END OF SECTION

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THIS PROJECT IS BEING ELECTRONICALLY BID AND HARD COPY BIDS WILL NOT BE ACCEPTED. Please review the instructions in the bid documents on how to register as an electronic bidder. The bids are to be prepared and submitted at www.biddocsonline.com . Tutorials and instructions on how to complete the electronic bid documents are available online (click on the "Tutorial" tab at the bottom footer).

ARTICLE 1 - BIDDER'S REPRESENTATION

1.1 Each General Bidder or Sub-bidder (hereinafter called the **"Bidder"**) by making a bid or sub-bid (hereinafter called **"bid"**) represents that:

1. The Bidder has read and understands the Contract Documents and the bid is made in accordance therewith.
2. The Bidder has visited the site and is familiar with the local conditions under which the Work has to be performed.

1.2 Failure to so examine the Contract Documents and site will not relieve any Bidder from any obligation under the bid as submitted.

ARTICLE 2 - GENERAL BIDDER'S AND FILED SUB-BIDDER'S CERTIFICATION

2.1 General bids shall be submitted with the following:

1. A Certificate of Eligibility on the appropriate form prescribed and issued by the Division of Capital Asset Management and Maintenance (DCAMM), showing that the Bidder is eligible to bid on projects of this size in the specified category of work (create a pdf file of the Certificate and browse & attach at www.biddocsonline.com); and
2. A Contractor Update Statement, DCAMM Form CQ3 (create a pdf file of the Update Statement and browse & attach at www.biddocsonline.com or complete the Update Statement online at www.biddocsonline.com).
3. The Contractor Update Statement (CQ3) is not a public record as defined in DCAMM regulation 810 CMR 8.06 and will not be open to public inspection.

2.2 Filed sub-bids shall be submitted with the following:

1. A Sub-Bidder Certificate of Eligibility on the appropriate form prescribed and issued by DCAMM showing that the sub-bidder is eligible to bid on public projects in the specified category of work (create a pdf file of the Certificate and browse & attach at www.biddocsonline.com); and
2. A Sub-Bidder Update Statement on a form prescribed by DCAMM (create a pdf file of the Update Statement and browse & attach at www.biddocsonline.com or complete the Update Statement online at www.biddocsonline.com).
3. The Sub-Bidder Update Statement is not a public record as defined in DCAMM regulation 810 CMR 8.06 and will not be open to public inspection.

2.3 It is the Bidder's responsibility to obtain the necessary forms from DCAMM and make application in sufficient time for evaluation of the application and issuance of a Certificate of Eligibility prior to bid.

2.4 Massachusetts law has requires all employees who work on Massachusetts public works construction sites must have no less than 10 hours of OSHA-approved safety and health training. See Chapter 306 of the Acts of 2004.

1. This law directs the Massachusetts Attorney General to restrain the award of construction contracts to any contractor who is in violation to this requirement and to restrain the performance of these contracts by non-complying contractors.
2. The Contractor and all subcontractors on this project will be required to provide certification of compliance with this requirement in accordance with the provisions of Section 007343 of these Contract Documents. Non-compliance with this new Massachusetts Law will disqualify you from bidding on public contracts.

ARTICLE 3 - REQUESTS FOR INTERPRETATION

3.1 Bidders shall promptly notify the Awarding Authority of any ambiguity, inconsistency, or error which they may discover upon examination of the Contract Documents, the site, and local conditions.

3.2 Bidders requiring clarification or interpretation of the Contract Documents shall make a written request to the Awarding Authority. The Awarding Authority will answer such requests if received seven (7) calendar days before the date for receipt of the bids.

3.3 Interpretation, correction, or change in the Contract Documents will be made by written Addendum which will become part of the Contract Documents. Neither the Awarding Authority nor the Designer will be held accountable for any oral interpretations, corrections, or changes.

3.4 Copies of addenda will be made available for inspection at the locations listed in the Advertisement where Contract Documents are on file or at www.biddocsonline.com. **Hard copies of the addenda will not be forwarded to the plan holders. The bidder is solely responsible for reviewing all addenda posted on the project website.**

ARTICLE 4 - PREPARATION AND SUBMISSION OF BIDS

4.1 Forms and Bid Preparation

Bids shall be submitted electronically on the **"Form for General Bid"** or the **"Form for Sub-Bid"** at www.biddocsonline.com, as appropriate and available at no cost.

The forms enclosed in the Project Manual shall not be extracted or used.

1. All bidders must complete and submit the electronic bidder registration form (**Electronic Bidder Signature Authorization Form** – hard copy) to BidDocs ONLINE Inc. The form must be received by BidDocs ONLINE Inc. at least three business days prior to the bidding opening for processing. The Awarding Authority, the Designer or BidDocs ONLINE Inc. will not be held accountable if the bidder fails to submit the electronic bidder registration form in a timely manner. Instructions to submit the form are in the Contract Documents and are available at www.biddocsonline.com (click on the "Tutorial" tab at the bottom footer).
2. All entries on the bid form shall be made online. Any documents that are attached to the bid must be in a pdf format.
3. Sums shall be expressed in both words and figures in the space indicated on the bid form. Where there is a discrepancy between the bid sum expressed in words and the bid sum expressed in figures, the words shall control. Note: The electronic bid forms match the "word" amount to the numeric "figure" amount entered.
4. If the requirement of Performance and Payment Bonds for filed sub-contractors is left blank by the General Bidder on the Form for General Bid, the Awarding Authority shall interpret this as a "yes". No increase in contract price will be allowed for providing these bonds. Note: The system requires that the general bidder explicitly acknowledge yes or no.
5. Costs for subcontractor's bond premiums shall be paid for by the General Contractor in accordance with M.G.L. c.149 §44F.

4.2 Bid Deposits shall be:

1. at least five percent (5%) of the greatest possible bid amount, considering all alternates;
2. made payable to the **Awarding Authority.**
3. conditioned upon faithful performance by the principal of the agreements contained in the bid, and
4. in the form of:

4.1 cash,

4.2 certified check, treasurer's or cashier's check issued by a responsible bank or trust company, or

4.3 bid bond issued by a surety company licensed to do business in the Commonwealth of Massachusetts.

Note: Both the "bid bond" or "check" bid deposits are to be scanned and uploaded to the system as a pdf file. **IMPORTANT NOTICE**: If the bidder elects to make a bid deposit in the form of "cash" or "check" the bidder must have the cash or check physically delivered to the Awarding Authority prior to the date and time of the bid opening.

5. retained until the execution and delivery of the Awarding Authority / Contractor Agreement if they represent the bid deposit of one of the three (3) lowest responsible and eligible General Bidders or one of the three (3) lowest Sub-

bidders in a filed sub-bid trade, or a sub-bidder listed by one of the three (3).lowest General Bidders.

4.3 Electronic Submission of Filed Sub-Bids

Sub-bids, including the bid deposit, DCAMM Sub-Bidder Certificate of Eligibility, DCAMM Sub-Bidder Update Statement and required miscellaneous forms noted in the bid documents shall be submitted electronically online at www.biddocsonline.com. No hard copy bids will be accepted.

The Bidder will receive an email confirming submission of the bid. Click on the email link to review and print the submitted bid documents. Keep the email as a **receipt** that the bid was submitted. **Note:** The Bidder may modify the bid at any time prior to the bid date and time advertised. The Bidder will receive a new email each time the Bidder re-submits the bid.

1. Date and time for receipt of bids is set forth in the Advertisement.
2. Timely submission of a bid online shall be the full responsibility of the Bidder. Note: The project countdown clock on the website is the official clock that will determine when the bids are due.

4.4 Electronic Submission of General Bids

General Bids, including the bid deposit, DCAMM Certificate of Eligibility, Prime /General Contractor Update Statement (CQ3) and required miscellaneous forms noted in the bid documents shall be submitted electronically online at www.biddocsonline.com . No hard copy bids will be accepted.

The Bidder will receive an email confirming submission of the bid. Click on the email link to review and print the submitted bid documents. Keep the email as a **receipt** that the bid was submitted. **Note:** The Bidder may modify the bid at any time prior to the bid date and time advertised. The Bidder will receive a new email each time the Bidder re-submits the bid.

1. Date and time for receipt of bids is set forth in the Advertisement.
2. Timely submission of a bid online shall be the full responsibility of the Bidder. Note: The project countdown clock on the website is the official clock that will determine when the bids are due.

4.5 Sub-Trade Solicitations

1. If the General Bidders are instructed to carry an amount for a given sub-trade listed under Item 2, General Bidders shall list the sub-trade, and amount provided by the Awarding Authority. The line under **bonds required** on the General Bid Form should be marked “no” in order for subparagraph 4.5.2.2 to be applicable.
2. Upon solicitation of a subcontractor to perform the work required by the sub-trade as mentioned in subparagraph 5.5.1, the selected General Contractor’s contract amount will be adjusted as follows:

2.1 The difference between the subcontract amount and the amount carried in the bid.

2.2 The total cost of the subcontractor's bonds, if the selected General Contractor requires such bonds after the solicitation is completed and if the selected General Contractor complied with 4.4.1 above, and

2.3 The resultant cost difference for General Contractor's Bonds premiums.

3. Overhead and Profit for supervision of the sub-trade in question shall be included by all General Bidders in Item 1.

4. Additional overhead and profit is not allowed on the incremental difference as stated in M.G.L. c.149 §44F (4)(a)(2) nor on the costs for the additional bond premiums.

4.6 Addenda

1. All modifications to the bid documents will be issued via an addendum. All registered plan holders will be electronically notified when addenda are issued. **Hard copies of the addenda will <u>not</u> be forwarded to the plan holders**. The Bidder is solely responsible for reviewing all addenda posted on the project website. The Bidder must acknowledge all addenda have been reviewed by selecting “yes” or “no” as part of the ebidding process. If the Bidder selects “no”, the Bidder will automatically be directed to the Addenda icon on the project page.

ARTICLE 5 - ALTERNATES

5.1 Each General Bidder shall acknowledge Alternates in Section C on the Form for General Bid by entering the dollar amount of addition or subtraction necessitated by each Alternate.

5.2 In the event an Alternate does not involve a change in the amount of the base bid, the Bidder shall so indicate by entering **"0" (numeric figure)** in the “Add” space provided for that Alternate.

5.3 Sub-bidders shall enter on the Form for Sub-bid the amount of addition or subtraction necessitated by each Alternate which pertains to the work of that trade. If an Alternate does not involve a change in the bid amount, indicate by entering **"0" (numeric figure)** in the “Add” space provided for that Alternate.

5.4 General Bidders shall enter on the Form for General Bid a single amount for each Alternate which shall consist of the Sub-bidders' amounts and the amount for work performed by the General Contractor.

5.5 The low Bidder will be determined on the basis of the sum of the base bid and the accepted alternates.

5.6 Alternates will be considered in numerical sequence as required by Chapter 149, Section 44G of the Massachusetts General Laws.

ARTICLE 6 - WITHDRAWAL OF BIDS

6.1 Before Opening of Bids

1. Any bid may be withdrawn (retracted) prior to the time designated for receipt of bids upon clicking the tab to "Retract Bid". The Bidder and the Awarding Authority will receive an email confirming that the bidder retracted the bid.
2. Withdrawn bids may be modified and resubmitted up to the time designated for the receipt of bids.

6.2 After Opening of Bids

Bidders may withdraw a bid, without penalty, any time up to the time of Award as defined in paragraph 6.1, and upon demonstrating, to the satisfaction of the – Awarding Authority, that a bona fide clerical error was made during the preparation of the bid. Failure to conclusively demonstrate a bona fide clerical error may result in forfeiture of the bid deposit.

6.3 In the event of a general bid withdrawal after opening of bids, the Awarding Authority shall consider the bid from next lowest eligible and responsible bidder.

6.4 Sub-bid Withdrawal/Substitution

1. **Selection -** Should a filed sub-bidder listed on the Form for General Bid of the selected General Contractor (per Article 7 of these instructions) withdraw its bid, be unable to provide performance and payment bonds as required by the selected General Contractor, or otherwise refuse to sign a subcontract with the selected General Contractor, the Awarding Authority and the selected General Contractor shall consider the other sub-bids to which the Awarding Authority and the selected General Contractor make no objection and substitute a new sub-bidder for such trade.

2. **Process:** If the selected General Contractor:

2.1 required bonds (on the Form for General Bid) for the sub-bidder who withdrew then the selected General Contractor's contract amount shall be adjusted to account for:

.1 the difference between the amount of the sub-bid listed on the Form for General Bid and the amount of the replacement sub-bid, and

.2 the incremental difference in the cost of the General Contractor bonds premiums, but

.3 there will be no compensation for additional subcontractor bond premiums

2.2 did not require bonds (on the Form for General Bid) for the sub-bidder who withdrew and now the selected General Contractor wants bonds from the replacement sub-bidder, then the selected General Contractor's contract amount shall be adjusted:

.1 to account for the difference between the amount of the sub-bid listed on the Form for General Bid and the amount of the replacement sub-bid,

.2 the amount for the new sub-bidder's performance and payment bonds, and

.3 the incremental difference in the cost of the General Contractor bond premiums.

3. There shall be no adjustment to the selected General Contractor's contract amount except as set forth in 6.4.2.1 and 6.4.2.2. Additional overhead and profit is not allowed on the incremental difference in the sub-bids or on the costs for the additional bond premiums.

ARTICLE 7 - CONTRACT AWARD

7.1 **Award** means both the determination and selection of the lowest, responsible and eligible bidder, by the Awarding Authority.

7.2 The Awarding Authority will award the contract to the lowest responsible and eligible bidder within thirty days, Saturdays, Sundays, and legal holidays excluded after the opening of bids in accordance with M.G.L. c.149 §44A.

7.3 The Contract will be awarded to the lowest responsible and eligible Bidder, except in the event of substitution as provided under M.G.L. c.149 §§44E and 44F, in which cases the procedure as required by said sections shall govern the award of the Contract.

7.4 The award of this Contract is subject to the approval of the Awarding Authority. Contracts without approval shall not be considered valid.

7.5 The Awarding Authority reserves the right to waive any informalities in or to reject any or all Bids if it be in the public interest to do so.

7.6 The Awarding Authority also reserves the right to reject any sub-bid if it determines that such sub-bid does not represent the bid of a person competent to perform the work as specified, or if less than three sub-bids are received for a sub-trade, or if bid prices are not reasonable for acceptance without further competition.

7.7 As used herein, the term "lowest responsible and eligible bidder" shall mean the General Bidder whose bid is the lowest of those Bidders demonstrably possessing the skill, ability, and integrity necessary for the faithful performance of the work, and who meets the requirements for Bidders set forth in M.G.L. c.149 §44A-J and is not debarred from bidding under M.G.L. c.l49 §44C; and who shall certify that they are able to furnish labor that can work in harmony with all other elements of labor employed or to be employed on the work.

ARTICLE 8 - FORMS REQUIRED FOR CONTRACT APPROVAL

8.1 Upon Award, the General Bidder shall complete the following forms to ensure prompt contract validation. These forms will be provided to the selected General Bidder by the

Awarding Authority. Submit (3) originals of each.

8.2 Awarding Authority / Contractor Agreement and Form of Corporate Vote.

8.3 Form of Contractor's Equal Employment Certification in accordance with the General Conditions.
Form of Sub-Contractor's Equal Employment Certification in accordance with the General Conditions.

8.4.1 Form of Performance Bond and Form of Payment Bond must be submitted by the General Contractor on the Awarding Authority's form, in accordance with the General Conditions. The dates on the bonds must coincide with the contract date, and a current Power-of-Attorney must be attached to each bond.

8.4.2 Performance and Payment Bonds must also be submitted for all filed subcontractors, if required by the General Bidder on its Form for General Bid, in the total amount of the subcontract payable to the General Contractor.

8.5.1 Insurance Certificates for the General Contractor and all **filed subcontractors** are required and must be submitted in accordance with the General Conditions.
8.5.2 General Contractors must indicate on special perils insurance or installation floater if stored materials are covered.

8.6 Form of Subcontract for all filed subcontractors - executed and submitted on the statutory subcontract form.

8.7 Statement of Management on Internal Accounting Controls and a Statement prepared by a CPA expressing an opinion to the state of Management Controls, as required by M.G.L. c.30 §39R. This applies to the General Contractor only.

ARTICLE 9 - CONTRACT VALIDATION

9.1 The Awarding Authority -Contractor Agreement shall not be valid until signed by the Authorized Signatory of the Awarding Authority.

9.2 The Notice to Proceed for construction shall not be issued until the Awarding Authority/Contractor Agreement has been validated by the Authorized Signatory of the Awarding Authority.

9.3 Incomplete or unacceptable submissions of forms required by paragraphs 8.2 - 8.7 will delay the validation of the Owner/Contractor Agreement by the Awarding Authority.

END OF SECTION

TUTORIAL # 1
eBidding REGISTRATION

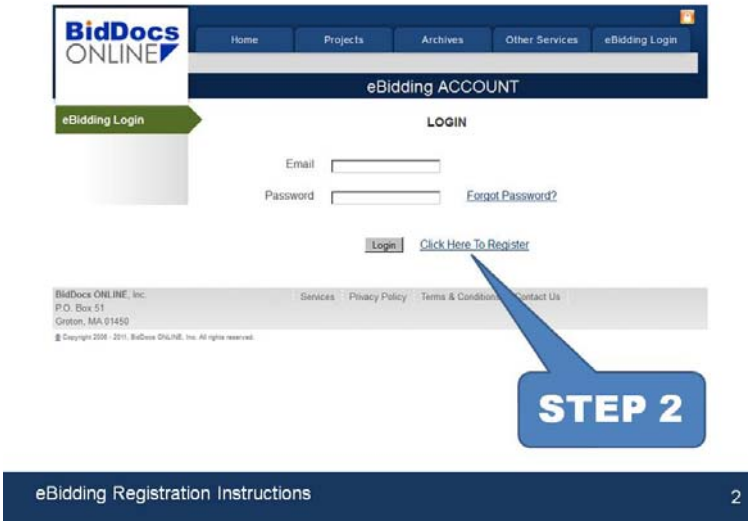
Below are the step by step instructions on how to register to use BidDocs ONLINE eBidding. There is no cost to register.

Start by going to:

www.biddocsonline.com

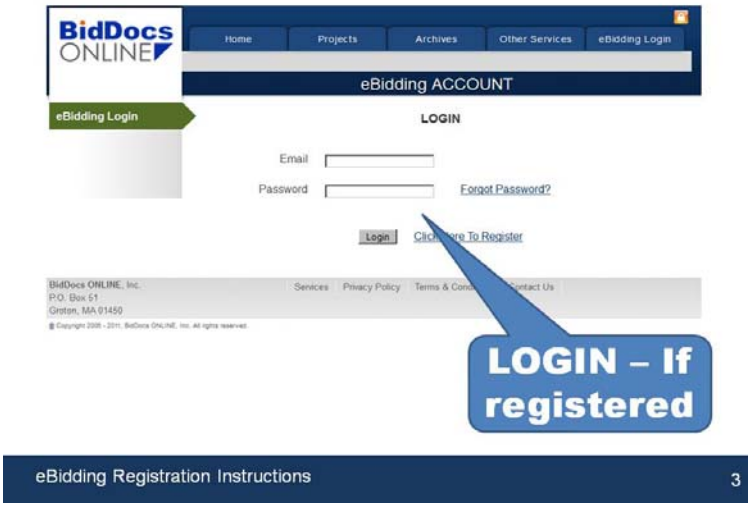
eBidding Registration Instructions 1

STEP 1: Click on the "eBidding Login" tab at the top of the page.



eBidding Registration Instructions 2

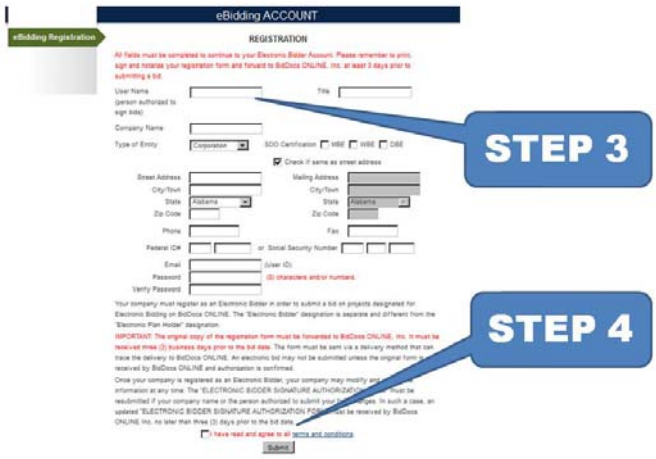
STEP 2a: If your company has not previously registered, click on the text "Click Here To Register".



eBidding Registration Instructions 3

STEP 2b: If your company has previously registered, login by entering the registered email address and password and then click the "Login" button.

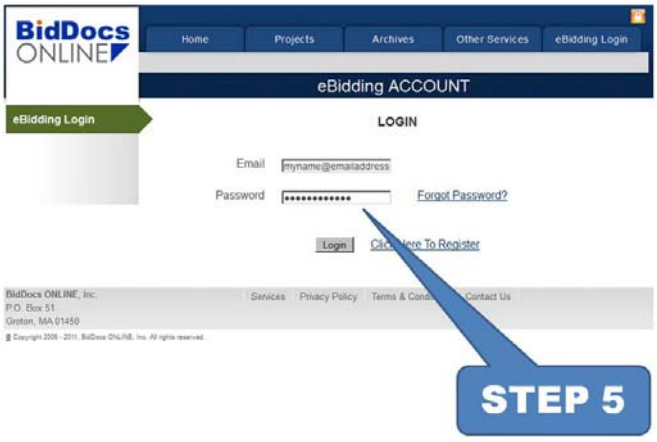
Note: Your company will have only one registration and all individuals must use the same email and password.



eBidding Registration Instructions 4

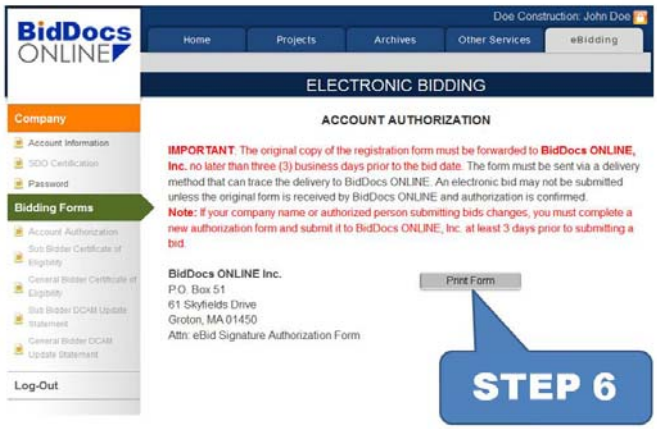
STEP 3: All fields must be completed in the registration form.

STEP 4: After completing the registration form, you must read and acknowledge the Terms and Conditions. Click the "Submit" button.



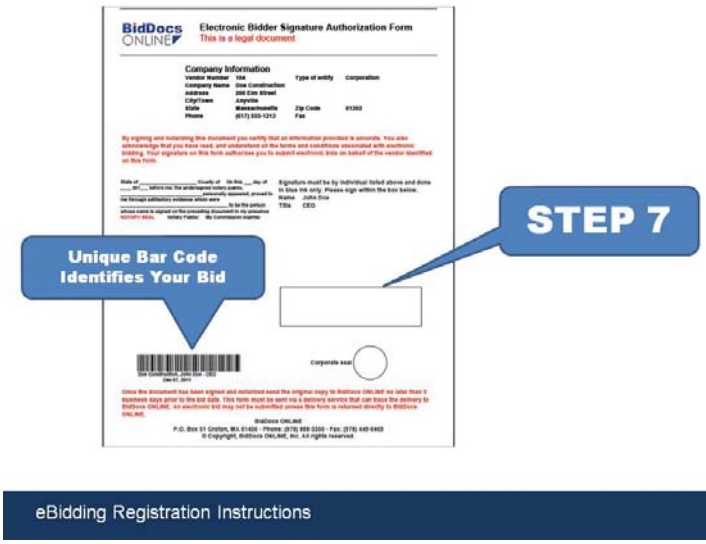
eBidding Registration Instructions 5

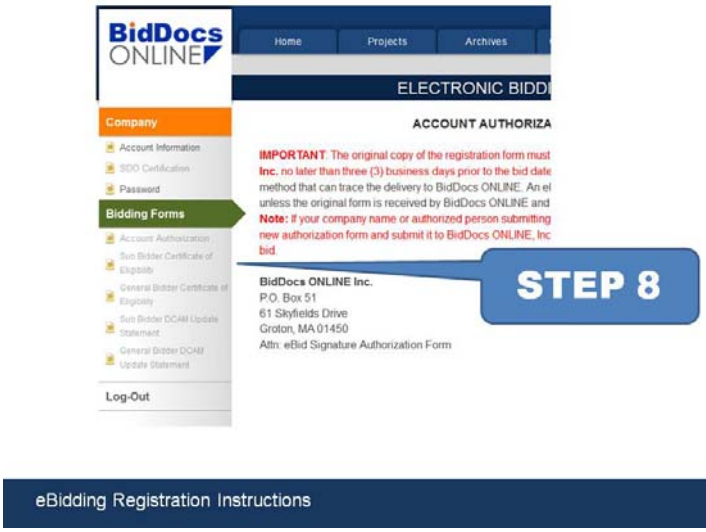
STEP 5: Enter the email and password previously created during the registration process and click "Login".



eBidding Registration Instructions 6

STEP 6: After logging in, the account authorization screen will appear. You must click "Print Form" to proceed to Step 7.





STEP 7: Print and notarize the form (sign in blue ink). Return the original "Electronic Bidder Signature Authorization Form" to BidDocs ONLINE Inc.

The mailing address is:
BidDocs ONLINE Inc.
P.O. Box 51
61 Skyfields Drive (for overnight)
Groton, MA 01450

Your company is responsible for ensuring that BidDocs ONLINE receives the signed Electronic Bidder Signature Authorization Form a minimum of three (3) business days prior to the bid date. BidDocs ONLINE will notify you by email that your form has been received and processed. A unique bar code will identify your bid paperwork.

Note: *The registration form will remain "active" until such time that your company requests a change in the person signing the form or a change in the company address or other pertinent company information. Your company is responsible for printing and resubmitting an updated form when changes occur.*

STEP 8: While the Electronic Bidder Signature Authorization Form is being processed, you may commence completing the common forms *(DCAM Eligibility and Sections 1-4 of the DCAM Update Statement)* that are required for MGL c. 149 bids.

Summary: **THIS PROJECT IS BEING ELECTRONICALLY BID AND HARD COPY BIDS WILL NOT BE ACCEPTED BY THE AWARDING AUTHORITY.** You must submit your bid electronically at www.biddocsonline.com. At any time during the bidding process, you may print the various bid documents for your company's records. Additional instructions to complete the other bid forms are accessible on the BidDocs ONLINE website (click on the "Tutorial" tab at the bottom footer).

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Section 00.41.00
FORM FOR GENERAL BID

TO THE AWARDING AUTHORITY

A. The undersigned proposes to furnish all labor and material required for _____ for the _____ in
Project
_____, Massachusetts, in accordance with the accompanying plans and specification prepared by _____ for
Name of Engineer or Architect
the contract price specified below, subject to additions and deductions according to the terms of the specifications.

B. This bid includes addenda numbered: _____

C. The proposed contract price is: _____

_____ Dollars $ _____
Bid Amount in Words **Bid Amount in Numbers**

			Subtract
For Alternate	No. _____	Add $ _____	$ _____
	No. _____	$ _____	$ _____
	No. _____	$ _____	$ _____
	No. _____	$ _____	$ _____
	No. _____	$ _____	$ _____

D. The subdivision of the proposed contract price is as follows:
ITEM 1. The work of the general contractor, being all work other than that covered by **ITEM 2.**

Total OF ITEM 1.....$ _____

ITEM 2. Sub-bids as follows:

Sub-trade	Name of Filed Sub-bidder	Sub-bid Amount	Bond Required Yes	No
_____	_____	_____	_____	
_____	_____	_____	_____	
_____	_____	_____	_____	
_____	_____	_____	_____	
_____	_____	_____	_____	

_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

TOTAL OF ITEM 2.....**$** _____

The undersigned agrees that each of the above named sub-bidders will be used for the work indicated at the amount stated, unless a substitution is made. The undersigned further agrees to pay the premiums for the performance and payment bonds furnished by sub-bidders as requested herein and that all of the cost of all such premiums is included in the amount set forth in Item l of this bid.

The undersigned agrees that if selected as general contractor, he will promptly confer with the awarding authority on the question of sub-bidders; and that the awarding authority may substitute for any sub-bid listed above a sub-bid filed with the awarding authority by another sub-bidder for the sub-trade against whose standing and ability the undersigned makes no objection; and that the undersigned will use all such finally selected sub-bidders at the amounts named in their respective sub-bids and be in every way as responsible for them and their work as if they had been originally named in this general bid, the total contract price being adjusted to conform thereto.

E. The undersigned agrees that, if he is selected as general contractor, he will within five days, Saturdays, Sundays, and legal holidays excluded, after presentation thereof by the awarding authority, execute a contract in accordance with the terms of this bid and furnish a performance bond and also a labor and materials or payment bond, each of a surety company qualified to do business under the laws of the Commonwealth and satisfactory to the awarding authority and each in the sum of the contract price, the premiums for which are to be paid by the general contractor and are included in the contract price; provided, however, that if there is more than 1 surety company, the surety companies shall be jointly and severally liable.

The undersigned hereby certifies that he is able to furnish labor that can work in harmony with all other elements of labor employed or to be employed on the work; that all employees to be employed at the worksite will have successfully completed a course in construction safety and health approved by the United States Occupational Safety and Health Administration that is at least 10 hours in duration at the time the employee begins work and who shall furnish documentation of successful completion of said course with the first certified payroll report for each employee; and that he will comply fully with all laws and regulations applicable to awards made subject to section 44A.

The undersigned further certifies under the 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 subsection the word "person" shall mean natural person, joint venture,

partnership, corporation or other business or legal entity. 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 there under.

NAME OF BIDDER

SIGNATURE AND TITLE OF PERSON SIGNING BID

Date: _____

BUSINESS ADDRESS

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SPECIAL NOTICE TO AWARDING AUTHORITY
BIDDERS' UPDATE STATEMENTS ARE NOT PUBLIC RECORDS AND ARE NOT OPEN TO PUBLIC INSPECTION (M.G.L. C.149, §44D)

EFFECTIVE MARCH 30, 2010

Commonwealth of Massachusetts
Division of Capital Asset Management
PRIME/GENERAL CONTRACTOR UPDATE STATEMENT

TO ALL BIDDERS AND AWARDING AUTHORITIES

A COMPLETED AND SIGNED PRIME/GENERAL CONTRACTOR UPDATE STATEMENT MUST BE SUBMITTED WITH EVERY PRIME/GENERAL BID FOR A CONTRACT PURSUANT TO M.G.L. c.149, §44A AND M.G.L. c. 149A. ANY PRIME/GENERAL BID SUBMITTED WITHOUT AN APPROPRIATE UPDATE STATEMENT IS INVALID AND MUST BE REJECTED.

Caution: This form is to be used for submitting Prime/General Contract bids. It is not to be used for submitting Filed Sub-Bids or Trade Sub-Bids.

AWARDING AUTHORITIES

If the Awarding Authority determines that the bidder does not demonstrably possess the skill, ability, and integrity necessary to perform the work on the project, it must reject the bid.

BIDDER'S AFFIDAVIT

I swear under the pains and penalties of perjury that I am duly authorized by the bidder named below to sign and submit this Prime/General Contractor Update Statement on behalf of the bidder named below, that I have read this Prime/General Contractor Update Statement, and that all of the information provided by the bidder in this Prime/General Contractor Update Statement is true, accurate, and complete as of the bid date.

_____
Bid Date

_____
Print Name of Prime/General Contractor

_____
Project Number (or name if no number)

_____
Business Address

_____
Awarding Authority

_____
Telephone Number

SIGNATURE⇨ _____

Bidder's Authorized Representative

INSTRUCTIONS

INSTRUCTIONS TO BIDDERS

- This form must be completed and submitted by all Prime/General contractors bidding on projects pursuant to M.G.L. c. 149, §44A and M.G.L. c. 149A.
- You must give complete and accurate answers to all questions and provide all of the information requested. MAKING A MATERIALLY FALSE STATEMENT IN THIS UPDATE STATEMENT IS GROUNDS FOR REJECTING YOUR BID AND FOR DEBARRING YOU FROM ALL PUBLIC CONTRACTING.
- **This Update Statement must include all requested information that was not previously reported on the Application used for your firm's most recently issued (not extended or amended) Prime/General Contractor Certificate of Eligibility. The Update Statement must cover the entire period since the date of your Application, NOT since the date of your Certification.**
- You must use this official form of Update Statement. Copies of this form may be obtained from the awarding authority and from the Asset Management Web Site: www.mass.gov/dcam .
- If additional space is needed, please copy the appropriate page of this Update Statement and attach it as an additional sheet.
- See the section entitled "Bidding Limits" in the *Instructions to Awarding Authorities* for important information concerning your bidding limits.

INSTRUCTIONS TO AWARDING AUTHORITIES

Determination of Bidder Qualifications

- It is the awarding authority's responsibility to determine who is the lowest eligible and responsible bidder. You must consider all of the information in the low bidder's Update Statement in making this determination. Remember: this information was not available to the Division of Capital Asset Management at the time of certification.
- The bidder's performance on the projected listed in Parts 1 and 2 must be part of your review. Contact the project references.
- AWARDING AUTHORITIES ARE STRONGLY ENCOURAGED TO REVIEW THE LOW BIDDER'S ENTIRE CERTIFICATION FILE AT THE DIVISION OF CAPITAL ASSET MANAGEMENT. Telephone (617) 727-9320 for an appointment.

Bidding Limits

Single Project Limit: The total amount of the bid, including all alternates, may not exceed the bidder's Single Project Limit.

Aggregate Work Limit: The annual value of the work to be performed on the contract for which the bid is submitted, when added to the annual cost to complete the bidder's other currently held contracts, may not exceed the bidder's Aggregate Work Limit. Use the following procedure to determine whether the low bidder is within its Aggregate Work Limit:

Step 1 Review Update Statement Question #2 to make sure that all requested information is provided and that the bidder has accurately calculated and totaled the annualized value of all incomplete work on its currently held contracts (column 9).

Step 2 Determine the annual dollar value of the work to be performed on your project. This is done as follows:

(i) If the project is to be completed in less than 12 months, the annual dollar value of the work is equal to the full amount of the bid.

(ii) If the project will take more than 12 months to complete, calculate the number of years given to complete the project by dividing the total number of months in the project schedule by 12 (calculate to 3 decimal places), then divide the amount of the bid by the calculated number of years to find the annual dollar value of the work.

Step 3 Add the annualized value of all of the bidder's incomplete contract work (the total of column 9 on page 5) to the annual dollar value of the work to be performed on your project. **The total may not exceed the bidder's Aggregate Work Limit**.

Correction of Errors and Omissions in Update Statements

Matters of Form: An awarding authority shall not reject a contractor's bid because there are mistakes or omissions of form in the Update Statement submitted with the bid, provided the contractor promptly corrects those mistakes or omissions upon request of the awarding authority. [810 CMR 8.05(1)].

Correction of Other Defects: An awarding authority may, in its discretion, give a contractor notice of defects, other than mistakes or omissions of form, in the contractor's Update Statement, and an opportunity to correct such defects, provided the correction of such defects is not prejudicial to fair competition. An awarding authority may reject a corrected Update Statement if it contains unfavorable information about the contractor that was omitted from the Update Statement filed with the contractor's bid. [810 CMR 8.05(2)].

PART 1 - COMPLETED PROJECTS

LIST ALL PUBLIC AND PRIVATE *BUILDING* PROJECTS YOUR FIRM HAS COMPLETED SINCE THE DATE OF APPLICATION FOR YOUR MOST RECENTLY ISSUED (NOT EXTENDED OR AMENDED) DCAM CERTIFICATE OF ELIGIBILITY. YOU MUST REPORT ALL REQUESTED INFORMATION NOT PREVIOUSLY REPORTED ON THAT DCAM APPLICATION*.

PROJECT TITLE & LOCATION	WORK CATEGORY	CONTRACT PRICE	START DATE	DATE COMPLETED

Attach additional sheets if necessary

* If your firm has been terminated from a project prior to completion of the work or has failed or refused to complete its work under any contract, full details and an explanation must be provided. See Part 3 of this Update Statement.

PROVIDE THE FOLLOWING REFERENCE INFORMATION FOR EACH COMPLETED PROJECT LISTED ON THE PREVIOUS PAGE.

PROJECT TITLE	COMPANY NAME CONTACT PERSON TELEPHONE
	OWNER: DESIGNER: GC:
	OWNER: DESIGNER: GC:
	OWNER: DESIGNER: GC:
	OWNER: DESIGNER: GC:
	OWNER: DESIGNER: GC:
	OWNER: DESIGNER: GC:

Is your company or any individual who owns, manages or controls your company affiliated with any owner, designer or general contractor named above, either through a business or family relationship? ☐ YES ☐ NO

Are any of the contact persons named above affiliated with your company or any individual who owns, manages or control your company, either through a business or family relationship? ☐ YES ☐ NO

If you have answered YES to either question, explain. _____

PART 2 - CURRENTLY HELD CONTRACTS

LIST ALL PUBLIC AND PRIVATE BUILDING AND NON-BUILDING *CONSTRUCTION* PROJECTS YOUR FIRM HAS UNDER CONTRACT ON THIS DATE REGARDLESS OF WHEN OR WHETHER THE WORK COMMENCED.

1	2	3	4	5	6	7	8	9
PROJECT TITLE & LOCATION	WORK CATEGORY	START AND END DATES	ON SCHEDULE (yes / no)	CONTRACT PRICE	% NOT COMPLETE	$ VALUE OF WORK NOT COMPLETE (col. 5 X col. 6)	NO. OF YEARS REMAINING (see note below)	ANNUALIZED VALUE OF INCOMPLETE WORK (col. 7 ÷ col. 8) (divided by)

ANNUALIZED VALUE OF ALL INCOMPLETE CONTRACT WORK (Total of Column 9) $_____

Column 8
- If less than one year is left in the project schedule, write 1.
- If more than 12 months are left in the project schedule, divide the number of months left in the project schedule by 12 (calculate to three decimal places).

PROVIDE THE FOLLOWING REFERENCE INFORMATION FOR EACH INCOMPLETE PROJECT LISTED ON THE PREVIOUS PAGE.

PROJECT TITLE	COMPANY NAME CONTACT PERSON TELEPHONE
	OWNER: DESIGNER: GC:
	OWNER: DESIGNER: GC:
	OWNER: DESIGNER: GC:
	OWNER: DESIGNER: GC:
	OWNER: DESIGNER: GC:
	OWNER: DESIGNER: GC:

Is your company or any individual who owns, manages or controls your company affiliated with any owner, designer or general contractor named above either through a business or family relationship? ☐ YES ☐ NO

Are any of the contact persons named above affiliated with your company or any individual who owns, manages or control your company, either through a business or family relationship? ☐ YES ☐ NO

If you have answered YES to either question, explain. _____

PART 3 - PROJECT PERFORMANCE

For Parts 3 and 4, if you answer YES to any question, please provide on a separate page a complete explanation. Information you provide herein must supplement the Application for your most recently issued (not extended or amended) DCAM Certificate of Eligibility. You must report all requested information not previously reported on that DCAM Application for Prime/General Certificate of Eligibility. Include all details [project name(s) and location(s), names of all parties involved, relevant dates, etc.].

	YES	NO
1. Has your firm been terminated on any contract prior to completing a project or has any officer, partner or principal of your firm been an officer, partner or principal of another firm that was terminated or failed to complete a project?	☐	☐
2. Has your firm failed or refused either to perform or complete any of its work under any contract prior to substantial completion?	☐	☐
3. Has your firm failed or refused to complete any punch list work under any contract?	☐	☐
4. Has your firm filed for bankruptcy, or has any officer, principal or individual with a financial interest in your current firm been an officer, principal or individual with a financial interest in another firm that filed for bankruptcy?	☐	☐
5. Has your surety taken over or been asked to complete any of your work under any contract?	☐	☐
6. Has a payment or performance bond been invoked against your current firm, or has any officer, principal or individual with a financial interest in your current firm been an officer, principal or individual with a financial interest in another firm that had a payment or performance bond invoked?	☐	☐
7. Has your surety made payment to a materials supplier or other party under your payment bond on any contract?	☐	☐
8. Has any subcontractor filed a demand for direct payment with an awarding authority for a public project on any of your contracts?	☐	☐
9. Have any of your subcontractors or suppliers filed litigation to enforce a mechanic's lien against property in connection with work performed or materials supplied under any of your contracts?	☐	☐
10. Have there been any deaths of an employee or others occurring in connection with any of your projects?	☐	☐
11. Has any employee or other person suffered an injury in connection with any of your projects resulting in their inability to return to work for a period in excess of one year?	☐	☐

PART 4 - Legal or Administrative Proceedings; Compliance with Laws

Please answer the following questions. Information must supplement all judicial and administrative proceedings involving bidder's firm, which were instituted or concluded (adversely or otherwise) since your firm's Application for your most recently issued (not extended or amended) Certificate of Eligibility. You must report all requested information not previously reported on that DCAM Application for Prime/General Certificate of Eligibility.

The term "administrative proceeding" as used in this Prime/General Contractor Update Statement includes (i) any action taken or proceeding brought by a governmental agency, department or officer to enforce any law, regulation, code, legal, or contractual requirement, except for those brought in state or federal courts, or (ii) any action taken by a governmental agency, department or officer imposing penalties, fines or other sanctions for failure to comply with any such legal or contractual requirement.

The term "anyone with a financial interest in your firm" as used in this Section "I", shall mean any person and/or entity with a 5% or greater ownership interest in the applicant's firm.

If you answer YES to any question, on a separate page provide a complete explanation of each proceeding or action and any judgment, decision, fine or other sanction or result. Include all details (name of court or administrative agency, title of case or proceeding, case number, date action was commenced, date judgment or decision was entered, fines or penalties imposed, etc.).

	YES	NO
1. Have any civil, judicial or administrative proceedings involving your firm or a principal or officer or anyone with a financial interest in your firm been brought, concluded, or settled relating to the procurement or performance of any construction contract, including but not limited to actions to obtain payment brought by subcontractors, suppliers or others?	☐	☐
2. Have any criminal proceedings involving your firm or a principal or officer or anyone with a financial interest in your firm been brought, concluded, or settled relating to the procurement or performance of any construction contract including, but not limited to, any of the following offenses: fraud, graft, embezzlement, forgery, bribery, falsification or destruction of records, or receipt of stolen property?	☐	☐
3. Have any judicial or administrative proceedings involving your firm or a principal or officer or anyone with a financial interest in your firm been brought, concluded, or settled relating to a violation of any state's or federal procurement laws arising out of the submission of bids or proposals?	☐	☐
4. Have any judicial or administrative proceedings involving your firm or a principal or officer or anyone with a financial interest in your firm been brought, concluded, or settled relating to a violation of M.G.L. Chapter 268A, the State Ethics Law?	☐	☐

PART 4 - Legal or Administrative Proceedings; Compliance with Laws (continued)

	YES	NO
5. Have any judicial or administrative proceedings involving your firm or a principal or officer or anyone with a financial interest in your firm been brought, concluded, or settled relating to a violation of any state or federal law regulating hours of labor, unemployment compensation, minimum wages, prevailing wages, overtime pay, equal pay, child labor or worker's compensation?	☐	☐
6. Have any judicial or administrative proceedings involving your firm or a principal or officer or anyone with a financial interest in your firm been brought, concluded, or settled relating to a violation of any state or federal law prohibiting discrimination in employment?	☐	☐
7. Have any judicial or administrative proceedings involving your firm or a principal or officer or anyone with a financial interest in your firm been brought, concluded, or settled relating to a claim of repeated or aggravated violation of any state or federal law regulating labor relations?	☐	☐
8. Have any proceedings by a municipal, state, or federal agency been brought, concluded, or settled relating to decertification, debarment, or suspension of your firm or any principal or officer or anyone with a financial interest in your firm from public contracting?	☐	☐
9. Have any judicial or administrative proceedings involving your firm or a principal or officer or anyone with a financial interest in your firm been brought, concluded, or settled relating to a violation of state or federal law regulating the environment?	☐	☐
10. Has your firm been fined by OSHA or any other state or federal agency for violations of any laws or regulations related to occupational health or safety? Note: this information may be obtained from OSHA's Web Site at www.osha.gov	☐	☐
11. Has your firm been sanctioned for failure to achieve DBE/MBE/WBE goals, workforce goals, or failure to file certified payrolls on any public projects?	☐	☐
12. Other than previously reported in the above paragraphs of this Section I, have any administrative proceedings or investigations involving your firm or a principal or officer or anyone with a financial interest in your firm been brought, concluded, or settled by any local, state or federal agency relating to the procurement or performance of any construction contract?	☐	☐
13. Are there any other issues that you are aware which may affect your firm's responsibility and integrity as a building contractor?	☐	☐

PART 5 - SUPERVISORY PERSONNEL

List all supervisory personnel, such as project managers and superintendents, who will be assigned to the project if your firm is awarded the contract. **Attach the resume of each person listed below**.

NAME	TITLE OR FUNCTION

PART 6 - CHANGES IN BUSINESS ORGANIZATION OR FINANCIAL CONDITION

Have there been any changes in your firm's business organization, financial condition or bonding capacity since the date your current Certificate of Eligibility was issued? ☐ Yes ☐ No
If YES, attach a separate page providing complete details.

PART 7 – LIST OF COMPLETED CONSTRUCTION PROJECTS SUBMITTED TO THE DIVISION OF CAPITAL ASSET MANAGEMENT.

Attach here a copy of the list of completed construction projects which was submitted with your firm's DCAM Application for your most recently issued (not extended or amended) DCAM Certificate of Eligibility. The Attachment must include a complete copy of the entire Section G – "Completed Projects" and the final page – "Certification" (Section J) containing the signature and date that the Completed Projects list (Section G) was submitted to the Division of Capital Asset Management.

Section 00.41.10
FORM FOR SUB-BID

TO ALL GENERAL BIDDERS EXCEPT THOSE EXCLUDED:

A. The undersigned proposes to furnish all labor and materials required for completing, in accordance with the hereinafter described plans, specifications and addenda, all the work specified in Section No. _____ of the specifications and in any plans specified in such section, prepared by _____ for _____ for the _____ in, _____ Massachusetts,

for the contract sum of:

_____ Dollars $ _____
Bid Amount in Words **Bid Amount in Numbers**

For Alternate	No. ____	Add $ _____	Subtract $ _____
	No. ____	$ _____	$ _____
	No. ____	$ _____	$ _____
	No. ____	$ _____	$ _____

Each Alternate shall be listed separately

B. This Sub-bid includes addenda numbered _____

C. This Sub-bid

☐ May be used by any General Bidder Except:

_____

_____

☐ May only be used by the following General Bidders:

_____

_____

To exclude general bidders, insert "X" in one box only and fill in blank following that box.
Do not answer C if no general bidders are excluded

D. The undersigned agrees that, if selected as a sub-bidder, he will, within five days, Saturdays, Sundays and legal holidays excluded, after presentation of a subcontract by the general bidder selected as the general contractor, execute with such general bidder a subcontract in accordance with the terms of this sub-bid, and contingent upon the execution of the general contract, and, if requested to do so in the general bid by such general bidder, who shall pay the premiums therefor, or if prequalification is required pursuant to Section 44D 3/4 , furnish a performance and payment bond of a surety company qualified to do business under the laws of the Commonwealth and satisfactory to the awarding authority, in the full sum of the subcontract price.

E. The names of all persons, firms and corporations furnishing to the undersigned labor or labor and materials for the class or classes or part thereof of work for which the provisions of the section of the specifications for this sub-trade require a listing in this paragraph, including the undersigned if customarily furnished by persons on his own payroll and in the absence of a contrary provision in the specifications, the name of each such class of work or part thereto and the bid price for such class of work or part thereof are:

NAME	CLASS OF WORK	BID PRICE

(Do not give bid price for any class or part thereof furnished by the undersigned).

F. The undersigned agrees that the above list of bids of the undersigned represents bona fide bids based on hereinbefore described plans, specifications and addenda, and that, if the undersigned is awarded the contract, they will be used for the work indicated at the amounts stated, if satisfactory to the awarding authority.

G. The undersigned further agrees to be bound to the general contractor by the terms of the hereinbefore described plans, specifications, including all general conditions stated therein, and addenda, and to assume toward him all the obligations and responsibilities that he, by those documents, assumes toward the owner.

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

1. Have been in business under present business name for _____ years
2. Ever failed to complete any work awarded? _____
3. List one or more recent buildings with names of general contractor and architect on which you served as subcontractor for work of similar character as required for the above-named building

Building Type	Architect	General Contractor		Contract Amount
			$	
			$	
			$	

4. Bank Reference: _____

I. The undersigned hereby certifies that he is able to furnish labor that can work in harmony with all other elements of labor employed or to be employed on the work; that all employees to be employed at the worksite will have successfully completed a course in construction safety and health approved by the United States Occupational Safety and Health Administration that is at least 10 hours in duration at the time the employee begins work and who shall furnish documentation of successful completion of said course with

the first certified payroll report for each employee; and that he will comply fully with all laws and regulations applicable to awards of subcontracts subject to section 44F. ***The safety training requirement in this paragraph is effective July 1, 2006.***

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

NAME OF SUB-BIDDER

SIGNATURE & TITLE OF PERSON SIGNING BID

BUSINESS ADDRESS

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*

SPECIAL NOTICE TO AWARDING AUTHORITY
SUB-BIDDERS' UPDATE STATEMENTS ARE NOT PUBLIC RECORDS AND ARE NOT OPEN TO PUBLIC INSPECTION (M.G.L. C.149, §44D)

EFFECTIVE MARCH 30, 2010

Commonwealth of Massachusetts
Division of Capital Asset Management

☐

SUB-BIDDER
UPDATE STATEMENT

TO ALL SUB-BIDDERS, TRADE CONTRACTORS AND AWARDING AUTHORITIES

A COMPLETED AND SIGNED SUB-BIDDER UPDATE STATEMENT MUST BE SUBMITTED WITH EVERY FILED SUB-BID PURSUANT TO M.G.L. c.149, §44F AND EVERY TRADE SUB-BID PURSUANT TO M.G.L. c. 149A. ANY FILED SUB-BID OR TRADE SUB-BID SUBMITTED WITHOUT AN APPROPRIATE SUB-BIDDER UPDATE STATEMENT IS INVALID AND MUST BE REJECTED.

Caution: This form is to be used for submitting Filed Sub-Bids and Trade Sub-Bids. It is not to be used for submitting Prime/General Contract bids.

AWARDING AUTHORITIES

If the Awarding Authority determines that the sub-bidder is not competent to perform the work as specified on the project, it should reject the bid.

SUB-BIDDER'S AFFIDAVIT

I swear under the pains and penalties of perjury that I am duly authorized by the bidder named below to sign and submit this Sub-bidder Update Statement on behalf of the bidder named below, that I have read this Sub-bidder Update Statement, and that all of the information provided by the bidder in this Sub-bidder Update Statement is true, accurate, and complete as of the bid date.

_____
Bid Date

_____
Print Name of Sub-bidder or Trade Contractor

_____
Project Number (or name if no number)

_____
Business Address

_____
Awarding Authority

_____
Telephone Number

SIGNATURE⇨ _____
Bidder's Authorized Representative

_____

INSTRUCTIONS

INSTRUCTIONS TO SUB-BIDDERS

- This form must be completed and submitted by all Filed Sub-Bidders bidding on projects pursuant to M.G.L. c. 149, §44F and Trade Contractors bidding on projects pursuant to M.G.L. c. 149A.
- You must give complete and accurate answers to all questions and provide all of the information requested. MAKING A MATERIALLY FALSE STATEMENT IN THIS SUB-BIDDER UPDATE STATEMENT IS GROUNDS FOR REJECTING YOUR BID AND FOR DEBARRING YOU FROM ALL PUBLIC CONTRACTING.
- **This Sub-Bidder Update Statement must include all requested information that was not previously reported on the Application used for your firm's most recently issued (not extended or amended) Sub-Bidder Certificate of Eligibility. The Sub-Bidder Update Statement must cover the entire period since the date of that Application, NOT since the date of your Certification.**
- You must use this official form of Sub-bidder Update Statement. Copies of this form may be obtained from the awarding authority and from the DCAM Web Site: www.mass.gov/dcam .
- If additional space is needed, please copy the appropriate page of this Sub-bidder Update Statement and attach it as an additional sheet.

INSTRUCTIONS TO AWARDING AUTHORITIES

Determination of Sub-Bidder Qualifications

- It is the awarding authority's responsibility to determine each responsible bidder. You must consider all of the information in the bidder's Sub-bidder Update Statement in making this determination. Remember: this information was not available to the Division of Capital Asset Management at the time of certification.
- The sub-bidder's performance on the projected listed in Parts 1 and 2 must be part of your review. Contact the project references.
- AWARDING AUTHORITIES ARE STRONGLY ENCOURAGED TO REVIEW THE SUB-BIDDER'S ENTIRE CERTIFICATION FILE AT THE DIVISION OF CAPITAL ASSET MANAGEMENT. Telephone (617) 727-9320 for an appointment.

Correction of Errors and Omissions in Sub-bidder Update Statements

Matters of Form: An awarding authority shall not reject a sub-bidder's bid because there are mistakes or omissions of form in the Sub-bidder Update Statement submitted with the bid pursuant to M.G.L. c.149, §44D, provided the sub-bidder promptly corrects those mistakes or omissions upon request of the awarding authority. [810 CMR 8.13(1)].

Correction of Other Defects: An awarding authority may, in its discretion, give a sub-bidder notice of minor defects and omissions as to form in the Sub-bidder's Update Statement and provide an opportunity to correct its Sub-bidder Update Statement. However, the sub-bidder shall not be allowed to make corrections to a Sub-bidder Update Statement if material information about the sub-bidder was omitted from the Sub-bidder Update Statement filed with the sub-bidder's bid. The Awarding Authority shall advise DCAM of any material omissions in a Sub-bidder's Update Statement.. [810 CMR 8.13(2)].

PART 1 - COMPLETED PROJECTS

LIST ALL PUBLIC AND PRIVATE PROJECTS OF $20,000 OR MORE THAT YOUR FIRM HAS COMPLETED SINCE THE DATE OF APPLICATION FOR YOUR MOST RECENTLY ISSUED (NOT EXTENDED OR AMENDED) SUB-BIDDER CERTIFICATE OF ELIGIBILITY*.

PROJECT TITLE & LOCATION	WORK CATEGORY	CONTRACT PRICE	START DATE	DATE COMPLETED

Attach additional sheets if necessary

* If your firm has been terminated from a project prior to completion of the work or has failed or refused to complete its work under any contract, full details and an explanation must be provided. See Part 3 of this Sub-bidder Update Statement.

PROVIDE THE FOLLOWING REFERENCE INFORMATION FOR EACH COMPLETED PROJECT LISTED ON THE PREVIOUS PAGE.

PROJECT TITLE	COMPANY NAME CONTACT PERSON TELEPHONE
	OWNER: DESIGNER: GC:
	OWNER: DESIGNER: GC:
	OWNER: DESIGNER: GC:
	OWNER: DESIGNER: GC:
	OWNER: DESIGNER: GC:
	OWNER: DESIGNER: GC:

Is your company or any individual who owns, manages or controls your company affiliated with any owner, designer or general contractor named above, either through a business or family relationship? ☐ YES ☐ NO

Are any of the contact persons named above affiliated with your company or any individual who owns, manages or control your company, either through a business or family relationship? ☐ YES ☐ NO

If you have answered YES to either question, explain. _____

PART 2 - CURRENTLY HELD CONTRACTS

LIST ALL PUBLIC AND PRIVATE PROJECTS OF $20,000 OR MORE THAT YOUR FIRM HAS UNDER CONTRACT ON THIS DATE REGARDLESS OF WHEN OR WHETHER THE WORK COMMENCED.

1	2	3	4	5	6	7
PROJECT TITLE & LOCATION	WORK CATEGORY	START AND END DATES	ON SCHEDULE (yes / no)	CONTRACT PRICE	% NOT COMPLETE	$ VALUE OF WORK NOT COMPLETE (col. 5 X col. 6)

PROVIDE THE FOLLOWING REFERENCE INFORMATION FOR EACH INCOMPLETE PROJECT LISTED ON THE PREVIOUS PAGE.

PROJECT TITLE	COMPANY NAME CONTACT PERSON TELEPHONE
	OWNER: DESIGNER: GC:
	OWNER: DESIGNER: GC:
	OWNER: DESIGNER: GC:
	OWNER: DESIGNER: GC:
	OWNER: DESIGNER: GC:
	OWNER: DESIGNER: GC:

Is your company or any individual who owns, manages or controls your company affiliated with any owner, designer or general contractor named above either through a business or family relationship? ☐ YES ☐ NO

Are any of the contact persons named above affiliated with your company or any individual who owns, manages or control your company, either through a business or family relationship? ☐ YES ☐ NO

If you have answered YES to either question, explain. _____

PART 3 - PROJECT PERFORMANCE

For Parts 3 and 4, if you answer YES to any question, please provide on a separate page a complete explanation. Information you provide herein must supplement the Application for your most recently issued (not extended or amended) Sub-Bidder Certificate of Eligibility. You must report all requested information not previously reported on that Application. Include all details [project name(s) and location(s), names of all parties involved, relevant dates, etc.].

	YES	NO
1. Has your firm been terminated on any contract prior to completing a project or has any officer, partner or principal of your firm been an officer, partner or principal of another firm that was terminated or failed to complete a project?	☐	☐
2. Has your firm failed or refused either to perform or complete any of its work under any contract prior to substantial completion?	☐	☐
3. Has your firm failed or refused to complete any punch list work under any contract?	☐	☐
4. Has your firm filed for bankruptcy, or has any officer, principal or individual with a financial interest in your current firm been an officer, principal or individual with a financial interest in another firm that filed for bankruptcy?	☐	☐
5. Has your surety taken over or been asked to complete any of your work under any contract?	☐	☐
6. Has a payment or performance bond been invoked against your current firm, or has any officer, principal or individual with a financial interest in your current firm been an officer, principal or individual with a financial interest in another firm that had a payment or performance bond invoked?	☐	☐
7. Has your surety made payment to a materials supplier or other party under your payment bond on any contract?	☐	☐
8. Has any subcontractor filed a demand for direct payment with an awarding authority for a public project on any of your contracts?	☐	☐
9. Have any of your subcontractors or suppliers filed litigation to enforce a mechanic's lien against property in connection with work performed or materials supplied under any of your contracts?	☐	☐
10. Have there been any deaths of an employee or others occurring in connection with any of your projects?	☐	☐
11. Has any employee or other person suffered an injury in connection with any of your projects resulting in their inability to return to work for a period in excess of one year?	☐	☐

PART 4 - Legal or Administrative Proceedings; Compliance with Laws

Please answer the following questions. Information must supplement all judicial and administrative proceedings involving bidder's firm, which were instituted or concluded (adversely or otherwise) since your firm's Application for your most recently issued (not extended or amended) Sub-Bidder Certificate of Eligibility. You must report all requested information not previously reported on that DCAM Application.

The term "administrative proceeding" as used in this Sub-Bidder Update Statement includes (i) any action taken or proceeding brought by a governmental agency, department or officer to enforce any law, regulation, code, legal, or contractual requirement, except for those brought in state or federal courts, or (ii) any action taken by a governmental agency, department or officer imposing penalties, fines or other sanctions for failure to comply with any such legal or contractual requirement.

The term "anyone with a financial interest in your firm" as used in this Section "I", shall mean any person and/or entity with a 5% or greater ownership interest in the applicant's firm.

If you answer YES to any question, on a separate page provide a complete explanation of each proceeding or action and any judgment, decision, fine or other sanction or result. Include all details (name of court or administrative agency, title of case or proceeding, case number, date action was commenced, date judgment or decision was entered, fines or penalties imposed, etc.).

	YES	NO
1. Have any civil, judicial or administrative proceedings involving your firm or a principal or officer or anyone with a financial interest in your firm been brought, concluded, or settled relating to the procurement or performance of any construction contract, including but not limited to actions to obtain payment brought by subcontractors, suppliers or others?	☐	☐
2. Have any criminal proceedings involving your firm or a principal or officer or anyone with a financial interest in your firm been brought, concluded, or settled relating to the procurement or performance of any construction contract including, but not limited to, any of the following offenses: fraud, graft, embezzlement, forgery, bribery, falsification or destruction of records, or receipt of stolen property?	☐	☐
3. Have any judicial or administrative proceedings involving your firm or a principal or officer or anyone with a financial interest in your firm been brought, concluded, or settled relating to a violation of any state's or federal procurement laws arising out of the submission of bids or proposals?	☐	☐
4. Have any judicial or administrative proceedings involving your firm or a principal or officer or anyone with a financial interest in your firm been brought, concluded, or settled relating to a violation of M.G.L. Chapter 268A, the State Ethics Law?	☐	☐

PART 4 - Legal or Administrative Proceedings; Compliance with Laws (continued)

	YES	NO
5. Have any judicial or administrative proceedings involving your firm or a principal or officer or anyone with a financial interest in your firm been brought, concluded, or settled relating to a violation of any state or federal law regulating hours of labor, unemployment compensation, minimum wages, prevailing wages, overtime pay, equal pay, child labor or worker's compensation?	☐	☐
6. Have any judicial or administrative proceedings involving your firm or a principal or officer or anyone with a financial interest in your firm been brought, concluded, or settled relating to a violation of any state or federal law prohibiting discrimination in employment?	☐	☐
7. Have any judicial or administrative proceedings involving your firm or a principal or officer or anyone with a financial interest in your firm been brought, concluded, or settled relating to a claim of repeated or aggravated violation of any state or federal law regulating labor relations?	☐	☐
8. Have any proceedings by a municipal, state, or federal agency been brought, concluded, or settled relating to decertification, debarment, or suspension of your firm or any principal or officer or anyone with a financial interest in your firm from public contracting?	☐	☐
9. Have any judicial or administrative proceedings involving your firm or a principal or officer or anyone with a financial interest in your firm been brought, concluded, or settled relating to a violation of state or federal law regulating the environment?	☐	☐
10. Has your firm been fined by OSHA or any other state or federal agency for violations of any laws or regulations related to occupational health or safety? Note: this information may be obtained from OSHA's Web Site at www.osha.gov	☐	☐
11. Has your firm been sanctioned for failure to achieve DBE/MBE/WBE goals, workforce goals, or failure to file certified payrolls on any public projects?	☐	☐
12. Other than previously reported in the above paragraphs of this Section I, have any administrative proceedings or investigations involving your firm or a principal or officer or anyone with a financial interest in your firm been brought, concluded, or settled by any local, state or federal agency relating to the procurement or performance of any construction contract?	☐	☐
13. Are there any other issues that you are aware which may affect your firm's responsibility and integrity as a building contractor?	☐	☐

PART 5 - SUPERVISORY PERSONNEL

List all supervisory personnel who will be assigned to the project if your firm is awarded the contract. **Attach the resume of each person listed below**.

NAME	TITLE OR FUNCTION

PART 6 - CHANGES IN BUSINESS ORGANIZATION OR FINANCIAL CONDITION

Have there been any changes in your firm's business organization, financial condition or bonding capacity since the date your current Certificate of Eligibility was issued? ☐ Yes ☐ No
If YES, attach a separate page providing complete details.

PART 7 – LIST OF COMPLETED CONSTRUCTION PROJECTS SUBMITTED TO THE DIVISION OF CAPITAL ASSET MANAGEMENT ALONG WITH CERTIFICATION PAGE.

Attach here a copy of the list of completed construction projects which was submitted with your firm's Application for your most recently issued (not extended or amended) Sub-Bidder Certificate of Eligibility. The Attachment must include a complete copy of the entire Section F – "Completed Projects" (Section G – "Completed Projects" for firms certified based upon their Prime/General Application), and the final page – "Certification Page", (Section I in the Sub-bidder Application or Section J in Prime/General Application) containing the signature and date that the Completed Projects list (Section F or G) was submitted to the Division of Capital Asset Management.

Section 00.52.00

AWARDING AUTHORITY/CONTRACTOR AGREEMENT

This agreement made the day of , by and between the Town of Montague Herinafter called the "Awarding Authority", and _____ hereinafter called the "Contractor"

Name of Contractor

Witnesseth, that the Awarding Authority and the Contractor, for the consideration hereinunder named, agrees as follows:

Article 1. Scope of Work: The Contractor shall perform all Work required by the Contract Documents for New DPW Facility referred to in the Contract Documents prepared by HELENE KARL Architects, Inc. as and referred to as the "Prime Designer".

Article 2. Time of Completion: The Contractor shall commence work under this Contract on the date specified in the written "Notice to Proceed" and shall bring the Work to Substantial Completion within __ calendar days of said date. Damages for delays in the performance of the Work shall be in accordance with Article 8 of the General Conditions of the Contract and/or a minimum of $500/day.

Article 3. Contract Sum: The Awarding Authority shall pay the Contractor, in current funds, for the performance of the Work, subject to additions and deductions by Change Order, of the Contract Sum of:

_____ **Dollars $** _____.

Contract Amount in Words | Contract Amount in Dollars

The Contract Sum is divided as follows:

Item 1: The work of the Contractor, being all Work other than that covered by Item 2

$ _____

Item 2: Subcontractors as follows

Section – Trade	Subcontractor	Amount
_____	_____	$_____
_____	_____	$_____
_____	_____	$_____
_____	_____	$_____
_____	_____	$_____
_____	_____	$_____
_____	_____	$_____
_____	_____	$_____
_____	_____	$_____
_____	_____	$_____
	Total for Item 2	$_____

Article 4. The Contract Documents: The following, together with this Agreement, form the Contract and all are as fully a part of the contract as if attached to this Agreement or repeated herein: The Advertisement, Bidding Documents, Contract Forms, General and Supplemental Conditions of the Contract, and Specifications as enumerated in the Table of Contents, the drawings as enumerated in the List of Drawings, Addenda and all Modifications issued after execution of the Contract. Terms used in this Agreement which are defined in the Conditions of the Contract shall have the meanings designated in those Conditions.

Article 5. Alternates: The following Alternates have been accepted and their costs are included in the Contract Sum stated in Article 3 of this Agreement: **Alternate No(s):_____**

Article 6. REAP Certification: Pursuant to M.G.L. c.62(c), sec.49(a), the individual signing this Contract on behalf of the Contractor, hereby certifies, under the penalties of perjury, that to the best of their knowledge and belief the Contractor has complied with all laws of the Commonwealth relating to taxes, reporting of employees and contractors, and withholding and remitting child support.

Article 7. Validation: This Contract will not be valid until signed by the Authorized Signatory.

In Witness Whereof, the Parties Hereto Have Caused This Instrument to be Executed Under Seal.

[1] **Contractor**	**Town of Montague**
_____	_____
Name of Contractor	Printed Name
_____	_____
Address	Signature and Seal
By: _____	_____
Signature and Seal	Title
Witness _____	Attest:

[1] If a Corporation, attach a notarized copy of the Corporate Vote authorizing signatory to sign Contract.

Section 00.52.03
FORM OF SUBCONTRACT

THIS AGREEMENT MADE THIS _____DAY OF ____ 20 __, by and between _____ a corporation organized and existing under the laws of ___ an individual doing business as ___ hereinafter called the "Contractor" and ____ a corporation organized and existing under the laws of _____ an individual doing business as _ hereinafter called the "Subcontractor".

1. The Subcontractor agrees to furnish all labor and materials required for the completion of all work specified in Section No. _____

of the specifications for _____ and the plans referred to therein and
(Name of Sub-Trade)
Addenda No. _____, _____, _____, and _____ for the:

New DPW Facility

all as prepared by HELENE KARL Architects, Inc. for the sum of __ ($ _____)

and the Contractor agrees to pay the Subcontractor said sum for said work. This price includes the following alternates **(and other items set forth in the sub-bid)**: Alternates No(s)._____

(a) The Subcontractor agrees to be bound to the Contractor by the terms of the hereinbefore described plans; specifications **(including all general conditions stated therein)** and Addenda No(s). ___, ___, ___, ___, and to assume to the Contractor all the obligations and responsibilities that the Contractor by those documents assumes to the Massachusetts Military Division, hereinafter called the "Awarding Authority", except to the extent that provisions contained therein are by their terms or by law applicable only to the Contractor.

(b) The Contractor agrees to be bound to the Subcontractor by the terms of the hereinbefore described documents and to assume to the Subcontractor all the obligations and responsibilities that the Awarding Authority by the terms of the hereinbefore described documents assumes to the Contractor, except to the extent that provisions contained therein are by their terms or by law applicable only to the Awarding Authority.

2. The Contractor agrees to begin, prosecute and complete the entire work specified by the Awarding Authority in an orderly manner so that the Subcontractor will be able to begin, prosecute and complete the work described in this subcontract; and, in consideration thereof, upon notice from the Contractor, either oral or in writing, the Subcontractor agrees to begin, prosecute and complete the work described in this Subcontract in an orderly

manner and with due consideration to the date or time specified by the Awarding Authority for the completion of the entire work.

3. The Subcontractor agrees to furnish to the Contractor within a reasonable time after the execution of this subcontract, evidence of workmen's compensation insurance as required by law and evidence of public liability and property damage insurance of the type and in limits required to be furnished to the Awarding Authority by the Contractor.

4. The Contractor agrees that no claim for services rendered or materials furnished by the Contractor to the Subcontractor shall be valid unless written notice thereof is given by the Contractor to the Subcontractor during the first ten (10) days of the calendar month following that in which the claim originated.

5. This agreement is contingent upon the execution of a general contract between the Contractor and the Awarding Authority for the complete work.

IN WITNESS WHEREOF, the parties hereto have executed this agreement the date and year first above-written.

SEAL

ATTEST _____ _____

Name of Subcontractor

By: _____

Signature

SEAL

ATTEST _____ _____

Name of Contractor

By: _____

Signature

Section 00.52.06

FORM OF CORPORATE VOTE

I hereby certify that a meeting of the Board of Directors of the:

_____

Name of Corporation

duly called and held at on the day of 20__
At which a quorum was present and acting, it was voted
that_____ of the , be and hereby is
Name of Corporate Officer
authorized to execute and deliver for and on behalf of the Corporation a Contract with the Town of Montague for work to be done at New DPW Facility in Turners Falls, , , Massachusetts. And to act as principal to execute bonds in connection therewith, which Contract and Bonds were presented to and made part of the records of said meeting. I further certify that _____ Is duly qualified and acting
Name of Corporate Officer
_____of the Corporation and that said vote has not been
Title
Repealed, rescinded or amended.

A true copy of the record,

Attest:

(CORPORATE SEAL)

On this ____ day of _____ 20____, before me, the undersigned Notary Public, personally appeared _____, duly designated by the board of directors and proved to me, through satisfactory evidence of identification, which was _____, that s/he is the person whose name is signed on the foregoing documents, and acknowledged to me that s/he signed it voluntarily for its stated purpose and that it was her/his free act and deed.

_____
Notary Public
My Commission Expires:

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Bond No._____

Section 00.61.01

PAYMENT BOND - CONTRACTOR

KNOW ALL MEN BY THESE PRESENTS:

That we, as **Principal**, and as **Surety,** are held and firmly bound unto the Town of Montague as **Obligee**, in the sum of **dollars_ $** to be paid to the Obligee, for which payments, well and truly to be made, we bind ourselves, our respective heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, the said **Principal** has made a contract with the **Obligee**, bearing the date of _____ 20 _ for the construction of New DPW Facility in Turners Falls, , , Massachusetts.

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, provisions of M.G.L. c.30 §39A, and M.G.L. c.149 §29, as amended, then this obligation shall become null and void; otherwise it shall remain in full force and virtue.

***IN WITNESS WHEREOF**, the **Principal** and **Surety** have hereunto set their hands and seals this:*

_____ Day of _____ 20__

PRINCIPAL _____ **SURETY** _____

BY: _____ **BY:** _____

SEAL **ATTORNEY-IN FACT**

ATTEST: _____ **ATTEST:** _____

The rate for this bond is _____ % for the first **$** _____ and _____ % for the next **$** _____

The total premium for this bond is **$** _____

This Page intentionally left blank

Bond No._____

Section 00.61.02

PERFORMANCE BOND - CONTRACTOR

KNOW ALL MEN BY THESE PRESENTS:

That we, as **Principal**, and as **Surety,** are held and firmly bound unto the Town of Montague, as **Obligee**, in the sum of **dollars_ $** to be paid to the Obligee, for which payments, well and truly to be made, we bind ourselves, our respective heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, the said **Principal** has made a contract with the **Obligee**, bearing the date of _____ 20 _ for the construction of New DPW Facility in Turners Falls, , , Massachusetts.

NOW, the condition of this obligation is 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 to said contract that may hereafter be made, notice to the **Surety** of such 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, that the contract is abandoned by the **Principal**, or in the event that the Obligee, under the provisions of Article 17 of the General Conditions of said contract terminates the employment of the **Principal** or the authority of the **Principal** to continue the work, said **Surety** hereby further agrees that said **Surety** shall, if requested in writing by the Obligee, take such action as is necessary to complete said contract.

IN WITNESS WHEREOF, the **Principal** and **Surety** have hereunto set their hands and seals this:

_____ Day of _____ 20__

PRINCIPAL _____ **SURETY** _____

BY: _____ **BY:** _____

SEAL **ATTORNEY-IN FACT**

ATTEST: _____ **ATTEST:** _____

The rate for this bond is _____ % for the first **$** _____ and _____ % for the next **$** _____

The total premium for this bond is **$** _____

Section 00.61.03

SUBCONTRACTOR'S PERFORMANCE AND PAYMENT BOND

KNOW ALL MEN BY THESE PRESENTS:

That we, _____ as **Principal**, hereinafter called the Subcontractor and _____ as **Surety**, are held and firmly bound unto

_____ , as **Obligee**, hereinafter called General Contractor in the sum of

_____ **dollars $** _____

lawful money of the United States of America to be paid to the Obligee, for which payments, well and truly to be made, we bind ourselves, our respective heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS THE SAID SUBCONTRACTOR entered into a certain subcontract with the said General Contractor bearing date of the ___ day of _____ , 20 ___ for: _____

_____

_____

which contract is by reference made a part hereof as fully and to the same extent as if copied at length herein.

NOW, THE CONDITION OF THIS OBLIGATION is such that if the subcontractor shall faithfully perform the subcontract and shall indemnify and hold harmless the General Contractor and the surety or sureties under the labor and materials or payment bond furnished by such General Contractor to the awarding authority against (l) any and all loss and expense arising out of any and all claims in connection with the performance of said subcontract which would be required to be paid under the labor and materials or payment bond furnished by the General Contractor to the awarding authority and (2) attorney's fees in the event the subcontractor after notice, fails to assume the defense of and defend such claims, then this obligation shall be null and void; otherwise it shall remain in full force and virtue.

IN WITNESS WHEREOF, the **Principal** and **Surety** have hereunto set their hands and seals this:

___ Day of _____ 20 ___

PRINCIPAL	_____	**SURETY**	_____
By:	_____ Seal	**By:**	_____ Attorney-in Fact Seal
Attest :	_____	**Attest**	_____

The rate for this bond is _____ % for the first **$** ____ and ____ % for the next **$** _____

The total premium for this bond is **$** _____

SECTION 00.72.00
GENERAL CONDITIONS OF THE CONTRACT FOR CONSTRUCTION
MGL c.149 Over $150,000
MASSACHUSETTS PUBLIC AWARDING AUTHORITY

TABLE OF CONTENTS

GENERAL CONDITIONS OF THE CONTRACT FOR CONSTRUCTION
MGL c. 149 OVER $150,000
ARTICLE 1
DEFINITION OF TERMS

1.1 BASIC DEFINITIONS

1.1.1 THE CONTRACT DOCUMENTS
The Contract Documents consist of the Awarding Authority-Contractor Agreement, Advertisement, Instructions to Bidders, Bidding Documents, Contract Forms, Conditions of the Contract, Specifications, Drawings, all addenda issued prior to execution of the Contract, and other documents listed in the Agreement and Modifications issued after execution of the Contract. A Modification is (1) a written amendment to the Contract signed by both parties, (2) a Change Order, (3) a Construction Change Directive or (4) a written order for a minor change in the Work issued by the Prime Designer.

1.1.2 THE CONTRACT
The Contract Documents form the Contract for Construction. The Contract represents the entire and integrated agreement between the parties hereto and supersedes prior negotiations, representations or agreements, either written or oral. The Contract may be amended or modified only by a Modification.

1.1.3 THE WORK
The term "Work" means the construction and services required by the Contract Documents, whether completed or partially completed, and includes all other labor, materials, equipment, and services provided or to be provided by the Contractor to fulfill the Contractor's obligations. The Work may constitute the whole or a part of the Project.

1.1.4 THE PROJECT
The Project is the total construction of which the Work performed under the Contract Documents may be the whole or a part and which may include construction by the Awarding Authority or by separate contractors.

1.1.5 THE DRAWINGS
The Drawings are the graphic and pictorial portions of the Contract Documents, wherever located and whenever issued, showing the design, location and dimensions of the Work, generally including plans, elevations, sections, details, schedules, and diagrams.

1.1.6 THE SPECIFICATIONS
The Specifications are that portion of the Contract Documents consisting of the written requirements for materials, equipment, construction systems, standards, and workmanship for the Work, and performance of related services.

1.2 EXECUTION, CORRELATION, AND INTENT

1.2.1 Execution of the Contract by the Contractor is a representation that the Contractor has visited the site, become familiar with local conditions under which the Work is to be performed and correlated personal observations with requirements of the Contract Documents.

1.2.2 The intent of the Contract Documents is to include all items necessary for the proper execution and completion of the Work by the Contractor. The Contract Documents are complementary, and what is required by one shall be as binding as if required by all. Performance by the Contractor shall be required only to the extent consistent with the Contract Documents and reasonably inferable from them as being necessary to produce the intended results. In case of inconsistent requirements in the Contract Documents, the requirement for the greater quantity or higher quality shall take precedence and shall be the Contract requirement.

1.2.3. Unless otherwise stated in the Contract Documents, words which have well known technical or construction industry meanings are used in the Contract Documents in accordance with such recognized meanings.

1.2.4. Where reference is made to standards or trade association publications, it shall be considered to refer to the latest edition and revision thereof, if any, in effect on the date the Contract Documents were advertised for bid.

1.3 USE OF DRAWINGS, SPECIFICATIONS, AND OTHER DOCUMENTS

The Drawings, Specifications and other documents prepared by the Prime Designer, and copies thereof furnished to the Contractor, are for use solely with respect to this Project. They are not to be used by the Contractor or any Subcontractor, Sub-subcontractor, or material or equipment supplier on other projects or for additions to this Project outside the scope of the Work without the specific written consent of the Awarding Authority and the Prime Designer.

ARTICLE 2
AWARDING AUTHORITY

2.1 DEFINITION

The term "Awarding Authority", sometimes also referred to as the " Authority" or " Owner", means the entity identified in the Awarding Authority - Contractor Agreement, organized and existing under the provisions of M.G.L. c.121B. The Awarding Authority shall designate in writing a person or persons with the authority to contractual act on behalf of the Awarding Authority. This person or these persons shall be the "authorized signatory". If the Awarding Authority designates more than one authorized signatory, then the Awarding Authority shall explicitly define the limits and scope of each individual's authority to contractually act on behalf of the Awarding Authority.

2.2 INFORMATION AND SERVICES TO BE PROVIDED BY THE AWARDING AUTHORITY

2.2.1 The Awarding Authority will furnish to the Contractor, free of charge, a minimum of three (3) copies or a reasonable number of copies of the Contract Documents for the execution of the Work, including a set for record purposes. In addition, the Awarding Authority, through the Prime Designer will furnish to the Contractor one black line print of detail and clarification drawings issued after the Contract has been awarded. The Contractor shall provide and distribute such number of prints as required for the Contractor's and Subcontractors' use. An electronic copy of the drawings (.dwg files) will be made available to the Contractor or subcontractors for a fee of $100/discipline or $300 for all disciplines made payable to the Prime Designer. The Contractor acknowledges that electronic version of the documents may vary from the hard copy version in the Contract Documents. In the case of variations, the hard copy Contract Documents shall govern and the Contract is solely responsible for reconciling any discrepancies. Furthermore, the Contract acknowledges that the electronic documents are for informational purposes only for the Project and neither the Awarding Authority nor the Prime Designer has any liability associated with the Contractor's use of the electronic documents.

2.2.2 The Awarding Authority shall furnish available surveys describing physical characteristics, legal limitations and utility locations for the site of the Project, and a legal description of the site.

2.3 AWARDING AUTHORITY'S RIGHT TO STOP THE WORK

2.3.1 If the Contractor fails to correct Work which is not in accordance with the requirements of the Contract Documents or persistently fails to carry out the Work in accordance with the Contract Documents, the Awarding Authority by written order signed personally or by its authorized agent, may order the Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated.

2.3.2 Stop work orders require the Awarding Authority's authorized signatory prior approval.

2.4 AWARDING AUTHORITY'S RIGHT TO CARRY OUT THE WORK

2.4.1 If the Contractor defaults or neglects to carry out the Work in accordance with the Contract Documents and fails within a seven - day (7) period after receipt of written notice from the Prime Designer at the Awarding Authority's direction to commence and continue correction of such default or neglect with diligence and promptness, the Awarding Authority may, without prejudice to other remedies, hire one or more contractors to correct such deficiencies.

2.4.2 In such case an appropriate Change Order shall be issued deducting from payments then or thereafter due the Contractor the cost of correcting such deficiencies, including compensation for the Prime Designer's additional services and expenses made necessary by such default, neglect, or failure. If payments then or thereafter due the Contractor are not sufficient to cover such amounts, the Contractor shall pay the difference to the Awarding Authority.

ARTICLE 3
CONTRACTOR

3.1 DEFINITION

The Contractor, sometimes referred to as the General Contractor, is the person or entity identified as such throughout the Contract Documents as if singular in number and is the entity awarded the Contract and responsible for performing the Work. The term Contractor means the Contractor or its authorized representative.

3.2 REVIEW OF CONTRACT DOCUMENTS & FIELD CONDITIONS BY CONTRACTOR

3.2.1 Before commencing the Work, the Contractor shall carefully study and compare the Contract Documents with each other and with information furnished by the Awarding Authority pursuant to Subparagraph 2.2.2 and shall at once report to the Prime Designer errors, inconsistencies, or omissions discovered. The Contractor shall not be liable to the Awarding Authority or Prime Designer for damage resulting from errors, inconsistencies, or omissions in the Contract Documents unless the Contractor recognized such error, inconsistency, or omission and knowingly failed to notify the Prime Designer. If the Contractor performs any construction activity knowing it involves a recognized error, inconsistency or omission in the Contract Documents without such notice to the Prime Designer, the Contractor shall assume responsibility for such performance and shall bear the attributable costs for correction.

3.2.2 Before commencing the Work, the Contractor shall take field measurements and verify field conditions and shall carefully compare such field measurements and conditions and other information known to the Contractor with the Contract Documents. Errors, inconsistencies, or omissions discovered shall be reported to the Prime Designer at once.

3.2.3 The Contractor shall perform the Work in accordance with the Contract Documents and submittals approved pursuant to Paragraph 3.7.

3.3 SUPERVISION AND CONSTRUCTION PROCEDURES, COORDINATION, AND CUTTING AND PATCHING

3.3.1 The Contractor shall supervise and direct the Work, using the Contractor's best skill and attention. The Contractor shall be solely responsible for and have control over construction means, methods, techniques, sequences and procedures, and for coordinating all portions of the Work under the Contract.

3.3.2 The Contractor shall be responsible for the proper fitting of all Work and the coordination of the operations of all trades, Subcontractors, or materialmen engaged upon the Work.

3.3.3 All necessary cutting, coring, drilling, grouting, and patching required to fit together the several parts of the Work shall be done by the Contractor, except as may be specifically noted otherwise under any particular filed sub-bid section of the Specifications.

3.3.4 The Contractor shall be responsible to the Awarding Authority for acts and omissions of the Contractor's employees, Subcontractors, and their agents and employees, and other persons performing portions of the Work.

3.3.5 The Contractor shall be responsible for inspection of portions of Work already performed under this Contract to determine that such portions are in proper condition to receive subsequent Work.

3.3.6 The Contractor shall do engineering required for establishing grades, lines, levels, dimensions, layouts, and reference points for the trades; shall be responsible for maintaining bench marks and other survey marks; and shall replace any bench marks or survey marks which have been disturbed or destroyed.

3.3.7 Unless otherwise required by the Contract Documents, or directed in writing by the Prime Designer, Work shall be done during regular working hours as established in the Contract Documents. However, if the Contractor desires to carry on the Work outside of regular working hours on Saturdays, Sundays or on Massachusetts and Federal holidays (irregular work hours), the Contractor shall notify the Awarding Authority at least three (3) calendar days in advance or shall allow the Awarding Authority ample time to make satisfactory arrangements for inspecting Work in progress. The Contractor shall bear the costs of such inspection and all Work performed during irregular work hours. The Awarding Authority shall bill the Contractor directly for any costs incurred for by the Awarding Authority to accommodate the irregular hour Work.

3.3.8 Work done outside of regular working hours without the consent or knowledge of the Prime Designer shall be subject to additional inspection and testing as directed by the Prime Designer. The cost of this inspection and testing shall be paid by the Contractor whether the Work is found to be acceptable or not. The Awarding Authority may issue a credit change order to cover such costs or may withhold such costs from any further payments due to the Contractor or the Contractor may issue a separate payment for such costs.

3.4 SUPERINTENDENT

3.4.1 The Contractor shall employ a Superintendent and necessary assistants who shall be in attendance at the Project site during performance of the Work. The Superintendent shall represent the Contractor, and communications given to the Superintendent shall be as binding as if given to the Contractor. Important communications shall be confirmed in writing. Other communications shall be similarly confirmed on written request in each case. The Superintendent shall attend each job meeting.

3.4.2 The Superintendent shall be a competent and responsible employee, satisfactory to the Awarding Authority, who is regularly employed by the Contractor and is designated by the Contractor as its representative to be in full time attendance at the Project site throughout the construction of the Work. The Superintendent shall be responsible for coordinating all the Work of the Contractor and the Subcontractors. The Superintendent shall be licensed consistent with the Massachusetts Building Code. The Superintendent's resume shall be submitted to the Awarding Authority prior to commencement of construction and must demonstrate to the Awarding Authority's reasonable satisfaction that the Superintendent has performed similar duties on previous construction projects similar to the Project.

3.5 LABOR

The Contractor shall enforce strict discipline and good order among the Contractor's employees and other persons carrying out the Work. The Contractor shall not permit employment of unfit persons or persons not skilled in tasks assigned to them, and whenever the Awarding Authority shall notify the Contractor, in writing, that any worker is, in its opinion, incompetent, unfaithful, disorderly, or otherwise unsatisfactory, such employee shall be discharged from the Work and shall not again be employed on the Project except with the consent of the Awarding Authority.

3.6 MATERIALS AND EQUIPMENT

3.6.1 Unless otherwise provided in the Contract Documents, the Contractor shall provide and pay for materials, equipment, tools, construction equipment and machinery, water, heat, utilities, transportation, and other facilities and services necessary for proper execution and completion of the Work, whether temporary or permanent and whether or not incorporated or to be incorporated in the Work.

3.6.2 Materials and Equipment to be installed as part of the Contract (both or either of which are hereinafter referred to as "Materials") shall be new, unused, of recent manufacture, assembled, and used in accordance with the best construction practices.

3.6.3 "OR EQUAL" SUBMISSIONS/SUBSTITUTIONS

3.6.3.1 Except where a product has been specified as a proprietary material, the words "or equal" are understood to follow the name of any maker, vendor, or product specified to be used in the Contract Documents. To determine if the materials or articles proposed by the Contractor are equal to those specified, the Prime Designer shall determine whether the materials or articles proposed are at least equal in quality, durability, appearance, strength and design to the material or articles named or described, and will perform at least equally the functions imposed by the design. See M.G.L. c.30 §39M.

3.6.3.2 The Contractor shall be responsible for providing the Prime Designer with any information and test results the Prime Designer reasonably requires to determine if a material is equal to a material named or described in the Contract Documents.

3.6.3.3 Whenever the Contractor submits a material for approval as a substitute for a material named or described in the Contract Documents, such submission shall be made at least one hundred and twenty (120) days prior to the date the materials will be used on the Project. In any case in which the time period specified in the Contract Documents from the Notice to Proceed to Substantial Completion is less that 120 days, the Prime Designer may modify this requirement. However, in no event shall the Contractor maintain a claim for delays based upon the Prime Designer's review of such substituted materials if the Contractor has failed to comply with the one hundred and twenty (120) day submission requirement.

3.6.3.4 Substitution Process:

a. On Substitution Request Form in Section 01.33.01, the Contractor shall direct attention to any deviations, including minor limitations and variations, from the Contract Documents.
b. The Contractor shall submit to the Prime Designer for consideration of any Or-Equal substitution a written point-by-point comparison containing the name and full particulars of the proposed product and the product named or described in the Contract Documents.
c. The Contractor shall be solely responsible for the timely submission of supporting documentation.
d. Upon receipt of a written request for approval of an Or-Equal substitution from the Contractor, the Prime Designer shall investigate whether the proposed item shall be considered equal to the item named or described in the Contract Documents. The Prime Designer will have up to 90 calendar days to perform the investigation and make an evaluation.
e. Upon conclusion of the investigation, the Prime Designer shall promptly advise the Awarding Authority in writing if the item is, or is not, considered acceptable as an Or-Equal substitution with documentation to support the determination.

f. The Prime Designer or Awarding Authority may require that full size samples of both the specified and proposed products be submitted for review and evaluation. The Contractor shall bear full cost for providing, delivering, and disposal of all such samples.
g. The Awarding Authority will then determine concurrence as to the equality of the submitted item and render an approval in writing within seven (7) calendar days after receipt of the Prime Designer's recommendation.
h. Should the Prime Designer determine that the submitted product substitution is not equal to the specified standard, the Prime Designer shall send written notice of this to the Contractor.
i. Proceeding with Work using the submitted item without the concurrence of the Awarding Authority may result in rejection of the Work and removal and replacement at the expense of the Contractor.
j. The Contractor shall assume full responsibility for the performance of any item submitted as an Or-Equal and assume the costs of any changes in any Work that may be caused by such substitution.

3.7 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES

3.7.1 Shop Drawings are drawings, diagrams, schedules, and other data specially prepared for the Work by the Contractor or a Subcontractor, Sub-subcontractor, manufacturer, supplier, or distributor to illustrate a portion of the Work.

3.7.2 Product Data are illustrations, standard schedules, performance charts, instructions, brochures, diagrams and other information furnished by the Contractor or its Subcontractors and suppliers to illustrate materials or equipment for some portion of the Work.

3.7.3 Samples are physical examples that illustrate materials, equipment, or workmanship and establish standards by which the Work will be judged.

3.7.4 Shop Drawings, Product Data, Samples, and similar submittals are not Contract Documents. The purpose of their submission is to demonstrate for those portions of the Work for which submittals are required the way the Contractor proposes to conform to the information given and the design concept expressed in the Contract Documents. Review by the Prime Designer is subject to the limitations of Subparagraph 3.7.9.

3.7.5 The Contractor shall review, approve, and submit to the Prime Designer Shop Drawings, Product Data, Samples and similar submittals required by the Contract Documents with reasonable promptness and in such sequence as to cause no delay in the Work or in the activities of the Awarding Authority or of separate contractors. Submittals made by the Contractor which are not required by the Contract Documents may be returned without action. The Contractor's attention is directed to the provisions of Subparagraph 3.6.3 entitled "Or Equal" Submissions/Substitutions and Section 01.30.00 of the Specifications.

3.7.6 The Contractor shall prepare and keep current, for the Prime Designer's approval, a schedule of submittals which is coordinated with the Contractor's construction schedule submitted pursuant to Paragraph 8.4, and allows the Prime Designer reasonable time to review submittals. The Prime Designer shall have up to fourteen (14) calendar days from receipt to review and take action on submittals, unless the Prime Designer notifies the Contractor in writing within seven (7) calendar days that no action will be taken on a submittal that must be coordinated with another submittal that the Contractor has not yet submitted. In this case, the Prime Designer shall have fourteen (14) calendar days from receipt of all associated submittals that must be coordinated together.

3.7.7 The Contractor shall perform no portion of the Work requiring submittal and review of Shop Drawings, Product Data, Samples or similar submittals until the Prime Designer has approved the respective submittal. Such Work shall be in accordance with approved submittals. Otherwise, the Contractor bears the solely responsibility and the associated costs for Work that may need to be re-accomplished because the Work does not comply with the approved submittal.

3.7.8 By approving and submitting Shop Drawings, Product Data, Samples and similar submittals, the Contractor represents that the Contractor has determined and verified materials, field measurements, and field construction criteria related thereto, or will do so, and has checked and coordinated the information contained within such submittals with the requirements of the Work and of the Contract Documents.

3.7.9 The Contractor shall not be relieved of responsibility for deviations from requirements of the Contract Documents by the Prime Designer's approval of Shop Drawings, Product Data, Samples or similar submittals unless the Contractor has specifically informed the Prime Designer in writing of such deviation at the time of submittal and the Awarding Authority has given explicit written approval to the specific deviation. The Contractor shall not be relieved of responsibility for errors or omissions in Shop Drawings, Product Data, Samples, or similar submittals by the Prime Designer's actions.

3.7.10 The Contractor shall direct specific attention, in writing or on resubmitted Shop Drawings, Product Data, Samples or similar submittals, to revisions other than those requested by the Prime Designer on previous submittals.

3.7.11 Informational submittals upon which the Prime Designer is not expected to take responsive action may be so identified in the Contract Documents.

3.7.12 When professional certification of performance criteria of materials, systems or equipment is required by the Contract Documents, the Prime Designer shall be entitled to rely upon the accuracy and completeness of such calculations and certifications.

3.8 SAMPLES AND TESTS

3.8.1 Materials to be used in the Work may be tested or inspected after reasonable notice by the Prime Designer and may be rejected if they fail the specified tests. Except as otherwise provided in the Contract, all testing of material specifically requested by the Prime Designer will be paid for by the Awarding Authority, except that the cost of testing of materials that fail the testing criteria shall be borne by the Contractor. If the Contractor requests permission to use a material that was not specified in the Contract Documents and the Prime Designer requires testing of such material before approving its use, the Contractor shall pay for such testing.

3.8.2 The source of material proposed by the Contractor shall be designated in time to permit all required testing and inspection before the material is needed for incorporation into the Work. The Contractor shall have no claim for delays due to testing if it fails to designate the proposed source or to order the material in time to provide for adequate testing and inspection. Necessary arrangements shall be made to permit the Prime Designer to make factory, shop, or other inspection of materials or equipment ordered for the Work, in process of manufacture or fabrication, or in storage elsewhere than the site of the Work.

3.8.3 The Contractor shall furnish the Prime Designer with samples of the materials it proposes to use in the execution of the Work in sufficient time to afford the Prime Designer the opportunity to adequately review and, if necessary, arrange for testing of such materials. The Prime Designer shall have fourteen (14) calendar days upon receipt to review all samples and shall issue written notification to the Contractor with seven (7) calendar days if additional time is required for testing such materials.

3.9 DELIVERY AND STORAGE OF MATERIALS

3.9.1 Materials and equipment shall be progressively delivered to the site so that there will be neither delay in the progress of the Work nor an undue accumulation of materials that are not to be used within a reasonable time.

3.9.2 Materials stored off-site shall be stored at the expense of the Contractor in a manner that preserves their quality and fitness for the Work.

3.9.3 If the Contractor requests the Prime Designer's inspection of materials stored off-site, the Contractor shall assume the Prime Designer's reasonable costs for time, travel, room, and meals associated with such inspection.

3.9.4 Materials stored either at the site or at some other location agreed upon in writing shall be located so as to facilitate prompt inspection and may again be inspected prior to their use in the Work.

3.9.5 The Contractor shall take charge of and be liable for any loss of or injury to the materials delivered at or in the vicinity of the place where the Work is being done and shall notify the Prime Designer as soon as any such materials are so delivered and allow them to be examined by the Prime Designer.

3.9.6 Payment for stored materials shall be made in accordance with Paragraph 9.4.

3.10 WARRANTY

The Contractor warrants to the Awarding Authority and Prime Designer that materials and equipment furnished under the Contract will be of good quality and new unless otherwise required or permitted by the Contract Documents, that the Work will be free from defects not inherent in the quality required or permitted, and that the Work will conform with the requirements of the Contract Documents. Work not conforming to these requirements, including substitutions not properly approved and authorized, may be considered defective. If required by the Prime Designer, the Contractor shall furnish satisfactory evidence as to the kind and quality of materials and equipment.

3.11 REJECTION OF DEFECTIVE MATERIALS

The Prime Designer may reject materials if the Prime Designer reasonably determines that such materials do not conform to the Contract Documents. No rejected materials, the defects of which have been subsequently corrected, shall be used in the Work except with the written permission of the Prime Designer. No extra time shall be allowed for completion of the Work due to the rejection of non-conforming materials.

3.12 REJECTION OF DEFECTIVE WORK

The Prime Designer's inspection of the Work shall not relieve the Contractor of any of its responsibilities to fulfill the Contract obligations, and defective Work shall be corrected. Unsuitable Work may be rejected by the Prime Designer, notwithstanding that such Work and materials have been previously overlooked or misjudged by the Prime Designer and accepted for payment. If the Work or any part thereof shall be found defective at any time before the final acceptance of the whole Work, the Contractor shall forthwith correct such defect in a manner satisfactory to the Prime Designer, and if any material brought upon the site for use in the Work, or selected for the same, shall be rejected by the Prime Designer as unsuitable or not in conformity with the Contract requirements, the Contractor shall forthwith remove such materials from the Work.

3.13 MATERIALS ATTACHED OR AFFIXED TO THE WORK

Nothing in this Contract shall be construed as vesting in the Contractor any right of property in the materials used after they have been attached or affixed to the Work or the soil; but all such materials shall, upon being so attached or affixed, become the property of the Awarding Authority.

3.14 SALES TAX EXEMPTION AND OTHER TAXES

3.14.1 All building materials and supplies as well as the rental charges for construction vehicles, equipment and machinery rented exclusively for use on the Project, or while being used exclusively for the transportation of materials for the Work are entitled to an exemption from sales taxes under M.G.L. c. 64H, s. 6(f). The Contractor shall take action required to obtain the benefit of such sales tax exemption. The Contractor shall bear the cost of any sales taxes that Contractor

incurs in connection with the Work and the Awarding Authority shall not reimburse the Contractor for any such taxes. The exemption number assigned to the Contractor as an exempt purchaser shall be provided to the Contractor by the Awarding Authority upon the written request of the Contractor.

3.14.2 The Contractor shall be responsible for paying all other taxes and tariffs of any sort, related to the Work.

3.15 DOCUMENTS AND SAMPLES AT THE SITE

The Contractor shall maintain at the Site for the use and information of the Awarding Authority, one record copy of the Drawings, Specifications, Addenda, Change Orders, and other Contract Modifications, in good order and marked currently to record changes and selections made during construction, and in addition approved Shop Drawings, Product Data, Samples, updated construction schedule, and similar required submittals. These shall be available to the Prime Designer and shall be delivered to the Prime Designer for submittal to the Awarding Authority upon completion of the Work.

3.16 PERMITS, FEES, AND NOTICES

3.16.1 The Contractor shall secure and pay for any and all permits, licenses, and fees required for the proper execution of the Work. The Contractor shall coordinate all efforts required to obtain these permits with the Awarding Authority's Project Manager or as otherwise provided in the Specifications.

3.16.2 The Contractor shall comply with and give notices required by laws, ordinances, rules, regulations, and lawful orders of public authorities bearing on performance of the Work.

3.16.3 It is not the Contractor's responsibility to ascertain that the Contract Documents are in accordance with applicable laws, statutes, ordinances, building codes, and rules and regulations. However, if the Contractor observes that portions of the Contract Documents are at variance therewith, the Contractor shall promptly notify the Prime Designer and Awarding Authority in writing, and necessary changes shall be accomplished by appropriate Modification.

3.16.4 If the Contractor performs Work knowing it to be contrary to laws, statutes, ordinances, building codes, and rules and regulations without such notice to the Prime Designer and Awarding Authority, the Contractor shall assume full responsibility for such Work and shall bear the attributable costs.

3.17 DEBRIS, CHEMICAL WASTE

3.17.1 The Contractor shall not permit the accumulation of debris, both exterior and interior, and the work area shall at all times be kept satisfactorily clean.

3.17.2 The Contractor shall remove debris from the site of the Work and legally dispose of it at any private or public dump that the Contractor may choose. The Contractor shall make all arrangements and obtain any approvals necessary for said disposal from the Awarding Authority's or officials in charge of such dumps and shall bear all cost, including fees resulting from such disposal. Garbage shall be removed daily.

3.17.3 No open fire shall be permitted on site.

3.17.4 Chemical Waste: Chemical waste shall be stored in corrosion resistant containers, removed from the Project site, and disposed of not less frequently than monthly unless directed otherwise. Disposal of chemical waste shall be in accordance with requirements of the U.S. Environmental Protection Agency (EPA) and the Massachusetts Department of Environmental Protection (DEP). Fueling and lubricating of vehicles and equipment shall be conducted in a manner that affords the maximum protection against spills

and evaporation. Lubricants to be discarded or burned shall be disposed of in accordance with approved procedures meeting all applicable Federal, State and local regulations. In the event of an oil or hazardous materials spill large enough to violate Federal, State, or applicable local regulations, the Contractor shall immediately notify the Awarding Authority and the Prime Designer. The Contractor shall be responsible for immediately cleaning up any oil or hazardous waste spills resulting from its operations. Any costs incurred in cleaning up any such spills shall be borne by the Contractor.

3.18 SITE AND WEATHER PROTECTION

3.18.1 The Contractor shall take precaution during the execution of Work involving demolition not to disturb or damage any existing structures, landscaping, walks, roads, or other items scheduled to remain. The Contractor shall restore any damaged items to original condition and as directed by the Prime Designer. The Contractor shall provide and erect acceptable barricades, fences, signs, and other traffic devices to protect the work from traffic and the public as reasonably necessary and as required by the Massachusetts Building Code.

3.18.2 The Contractor shall install weather protection and provide adequate heat in the protected area from November 1 to March 31 as required by M.G.L. c.149 §44G. The Contractor shall pay for all weather protection and temporary heat required for the Project.

3.19 ARCHAEOLOGICAL AND HISTORICAL RESOURCES

All items having any apparent historical or archaeological interest which are discovered in the course of any construction activities shall be carefully preserved and reported immediately to the Prime Designer for determination of appropriate actions to be taken.

3.19.1 If the nature of the item is such that the Work cannot proceed without danger of damaging same, Work in that area shall be immediately discontinued until the Awarding Authority has decided the proper procedure to be followed.

3.19.2 Any time lost thereby shall be a condition for which the time of the Contract may be extended.

3.19.3 All costs incurred after discovery in the salvaging of such items shall be borne by the Awarding Authority.

3.20 SAFETY REQUIREMENTS

3.20.1 The Contractor must comply with all Federal, State, and Local safety laws and regulations of the applicable to work performed under this Contract.

3.20.1.1 Before commencing any portion of the Work, the Contractor shall submit a written Project-specific plan for implementing this Section. The plan shall include an analysis of the significant hazards to life, limb and property inherent in the performance of the Work and a plan for controlling those hazards. The Contractor is solely responsible for implementing and maintaining the safety requirements on the Project.

3.20.1.2 The Contractor shall be responsible for its Subcontractors' compliance with the provisions of this Section.

3.20.2 In performing the Work, the Contractor shall:

3.20.2.1 Ensure that no laborer or mechanic shall be required to work in surroundings or under working conditions which are unsanitary, hazardous, or dangerous to his/her health and/or safety as determined under construction safety and health standards promulgated by the U.S. Secretary of Labor by regulation;

3.20.2.2 Protect the lives, health and safety of other persons and shall,

a. Comply with 84 Stat. 1590, the “Occupational Safety and Health Act of 1970” (OSHA) and with regulations and standards issued by the U.S. Secretary of Labor at 29 CFR Part 1926; and
b. Comply with the Trench Safety Law set forth in M.G.L. c. 82A and regulations promulgated by the Departments of Public Safety (DPS) and Occupational Safety (DOS) in 520 CMR 14.00 et seq.; the Contractor shall execute a Trench Application and Permit form with the execution of its contract.
c. Comply with M.G.L. c. 149, s. 129A, relative to shoring and bracing of trenches.
d. If the Contractor uses or stores toxic or hazardous substances, comply with M.G.L. c.1 1 1F §2, the "Right to Know" law and regulations promulgated by the Department of Public Health, 105 CMR 670, the Department of Environmental Protection, 310 CMR 33, and the Department of Labor and Workforce Development, 441 CMR 21; and must post a Workplace Notice obtainable from the Department of Labor and Workforce Development.
e. Comply with the Federal Resource Conservation and Recovery Act, the Federal Comprehensive Environmental Response Compensation and Liability Act, M.G.L. c. 21C, M.G.L. c. 21E, and any other Laws affecting toxic or hazardous materials, solid, special or hazardous waste (collectively “Hazardous Materials Laws”). Should the Contractor discover unforeseen materials subject to Hazardous Materials Laws at the Site, the Contractor shall immediately comply with any and all requirements for dealing with such materials and notify all required governmental authorities and the Owner of such discovery.
f. Include these terms in every subcontract so that such terms will be binding on each subcontractor.
g. Designate by notice to the Owner a responsible member of its organization at the Site whose duties shall include ensuring safety, implementation of Contractor’s Safety Plan referenced below and preventing accidents.

3.20.3 The Contractor shall maintain an accurate record of exposure data on all accidents incident to the Work resulting in death, traumatic injury, occupational disease, or damage to property, materials, supplies, or equipment, and shall report this data in the manner prescribed by 29 CFR 1904. Without limiting the foregoing, the Contractor shall submit to the Awarding Authority without delay verbal and written reports of all accidents involving bodily injury or property damage arising in connection with the Work.

3.20.4 In any emergency affecting the safety of persons or property, the Contractor shall immediately act in the exercise of reasonable judgment to prevent threatened damage, injury or loss. The Contractor shall immediately notify the Awarding Authority of such emergency.

3.20.5 The Contractor shall be responsible for the location of utilities in connection with the Work. Without limiting the foregoing, the Contractor shall comply with Dig-Safe Laws. Dig-Safe is the Utility Underground Plant Damage Prevention System, 331 Montvale Ave., Woburn, MA 01801, 1.888.344.7233. The Contractor shall notify Dig-Safe of contemplated excavation, demolition, or explosive work in public or private ways, and in any utility company right of way or easement, by certified mail, with a copy to Department of Environmental Protection (DEP). This notice shall be given at least 72 hours prior to the work, but not more than sixty days before the work is to be done. Such notice shall state the name of the street or the route number of the way and shall include an accurate description of the location and nature of the proposed work. Dig-Safe is required to respond to the notice within 72 hours of receipt by designating the location of pipes, mains, wires or conduits at the site. The Contractor shall not commence work until Dig-Safe has responded. The Work shall be performed in such manner and with reasonable precautions taken to avoid damage to utilities under the surface at the Work location. The Contractor shall provide the Superintendent with current Dig-Safe regulations, and a copy of M.G.L. c.82 §40. Any costs related to the services performed by Dig-Safe shall be borne by the Contractor.

3.20.6 If this Project requires the containment or removal of asbestos or material containing asbestos, lead or waste containing lead based paint, the Contractor shall ensure that the person or company performing the asbestos or lead related services is licensed pursuant to applicable State laws and regulations.

3.20.7 Without limiting the Contractor's responsibilities described above, the Contractor shall take all reasonable precautions for the safety of, and the prevention of injury or damage to (1) all agents and employees and contractors on the Work and all other persons who may be affected thereby including the general public, (2) all the Work and all materials and equipment to be incorporated therein, whether in storage on or off the Site, under the care custody or control of the Contractor or any of its Subcontractors or any contractors directly or indirectly contracting through any of them, and (3) other property at the Site or adjacent thereto, including but not limited to trees, shrubs, lawns, walks, pavements, roadways, structures and utilities not designated for removal, relocation or replacement in the course of the Work. The Contractor shall promptly remedy all damage or loss to any such property caused in whole or in part by the Contractor, any Subcontractor, or anyone directly or indirectly contracted or employed by any of them or by anyone for whose acts any of them may be liable. Without limiting the foregoing, the Contractor shall:

(1) Post and maintain adequate danger signs and other warnings against hazards;
(2) Promulgate safety regulations and give appropriate notices to the Owner and users of adjacent utilities and property;
(3) Insure the adequate strength and safety of all scaffolding, staging and hoisting equipment, temporary shoring, bracing and tying;
(4) Protect adjoining private or public property;
(5) Provide barricades, temporary fences, and covered walkways required by prudent construction practices, Laws, and/or the Contract Documents;
(6) Furnish approved hard hats and other personal protective equipment, furnish approved first aid supplies, furnish the name of the first aid attendant, and maintain a posted list of emergency facilities;
(7) Provide a proper means of access to property where the existing access is cut off by the Contractor;
(8) Maintain from the beginning of any darkness or twilight through the whole of every night sufficient lights on or near any obstruction so as to guard and protect travelers from injury from such obstruction;
(9) Maintain adequate security at the Site so as not to expose the Work and surrounding property to vandalism or malicious mischief;
(10) Provide adequate fire protection procedures during the use of cutting torches, welding equipment, plumbers' torches and other flame and spark producing apparatus; and
(11) Take prompt action to correct any dangerous or hazardous conditions.

3.20.8 The Contractor shall not use or store explosives in the performance of the Work unless the Contractor first obtains the Owner's prior written approval. If the Owner approves the use or storage of explosives during the performance of the Work, the Contractor shall first comply with all Laws and obtain all permits, approvals, and certificate required in connection with the same and shall exercise best efforts, including but not limited to the employment and supervision of properly qualified personnel, to prevent damage, injuries, and accidents involving said explosives.

3.20.9 The Contractor shall not permit cutting or welding in or immediately adjacent to existing property of the Owner or of anyone else without the Owner's prior approval in each instance.

3.21 ACCESS TO WORK

The Contractor shall provide the Awarding Authority and Prime Designer access to the Work at all times and shall cooperate with the Awarding Authority whenever the Awarding Authority invites visitors to the site.

3.22 MEETINGS AND PROJECT DIRECTORY

3.22.1 Meetings: The Contractor shall attend the pre-construction meeting, the regular job meetings and the final punchlist inspections. The meetings will be schedule by the Prime Designer at a mutually agreed upon time by the Awarding Authority, the Prime Designer and the Contractor. The Contractor's representative that attends the meeting shall have authority to act on behalf of the Contractor. If requested by the Prime Designer, the Contractor's Superintendent shall attend the regular job meetings.

3.22.2 Project Directory: Prior to the commencement of construction, the Contractor shall submit a Project Directory, in writing, that includes the Contractor's personnel, subcontractors and principal vendors on the Project. The Directory shall include the trade, company name, company address, company phone number and the contact person's name and direct phone number for each company. In addition, the Project Directory shall include an the telephone number of a responsible person that may be contacted during non-work-hours for emergencies on the Project. The Contractor shall regularly update the Project Directory and submit a final copy of the Project Directory as part of the Project close-out documentation.

ARTICLE 4
ADMINISTRATION OF THE CONTRACT

4.1 PRIME DESIGNER

The Prime Designer is the person or entity licensed to practice architecture or engineering, who is responsible for performing the duties assigned to the Prime Designer by the Contract Documents.

4.2 COMMUNICATIONS FACILITATING CONTRACT ADMINISTRATION

Except as otherwise provided in the Contract Documents or when direct communications have been specially authorized, the Awarding Authority and Contractor shall communicate through the Prime Designer. Communications by and with the Prime Designer's consultants shall be through the Prime Designer. Communications by and with Subcontractors and material suppliers shall be through the Contractor. Communications by and with separate contractors shall be through the Awarding Authority.

4.3 PRIME DESIGNER'S ADMINISTRATION OF THE CONTRACT

4.3.1 The Prime Designer will provide administration of the Contract as described in the Contract Documents, and will be the Awarding Authority's representative (1) during construction, (2) until final payment is due and (3) with the Awarding Authority's concurrence, from time to time during the guaranty period described in Article 10. The Prime Designer will advise and consult with the Awarding Authority.

4.3.2 The Prime Designer will regularly visit the site, conduct job meetings, and keep the Awarding Authority informed of the progress and quality of the Work, and will endeavor to guard the Awarding Authority against defects and deficiencies in the Work. The Prime Designer's minutes of meetings shall be the official minutes kept on the Project.

4.3.3 Based on the Prime Designer's observations and evaluations of the Contractor's Applications for Payment, the Prime Designer will review and certify the amounts due the Contractor and will submit to the Awarding Authority for their consideration Certificates for Payment in such amounts as the Prime Designer determines appropriate.

4.3.4 The Prime Designer shall reject Work that does not conform to the Contract Documents. Whenever the Prime Designer considers it necessary or advisable to achieve the intent of the Contract Documents, the Prime Designer will have authority to require additional inspection or testing of the Work in accordance with Paragraph 3.8.

4.3.5 The Prime Designer will review and approve or take other appropriate action upon the Contractor's submittals such as Shop Drawings, Product Data and Samples within 14 calendar days, but only for the limited purpose of checking such submittals for conformance with the information given and the design concept expressed in the Contract Documents. This review shall be in accordance with the provisions of Subparagraph 3.6.3 and the procedures described in Section 01.30.00 of the Specifications and shall not relieve the Contractor from compliance with the requirements of the Contract Documents.

4.3.6 The Prime Designer will prepare Change Orders and Construction Change Directives, and may authorize Minor Changes in the Work as provided in Paragraph 7.1.

4.3.7 The Prime Designer will conduct inspections to determine the date or dates of Substantial Completion and the date of Final Completion, will receive and forward to the Awarding Authority for the Awarding Authority's review and records written warranties and related documents required by the Contract and assembled by the Contractor, and will issue a final Certificate for Payment upon the Contractor's compliance with the requirements of the Contract Documents.

4.3.8 The Awarding Authority may provide one or more project representatives to assist in carrying out the Prime Designer's responsibilities at the Site. The duties, responsibilities, and limitations of authority of such project representatives shall be explained at the pre-construction conference.

4.3.9 The Prime Designer will interpret and decide matters concerning performance under and requirements of the Contract Documents on written request of either the Awarding Authority or Contractor. The Prime Designer's written response to such requests will be made within the thirty-day time limit prescribed in Paragraph 7.6.3.

4.3.10 The Prime Designer's decisions on matters relating to aesthetic effect will be final if consistent with the intent expressed in the Contract Documents.

4.4 PRE-CONSTRUCTION CONFERENCE

Prior to commencement of the Work, the Contractor shall meet in conference with representatives of the Awarding Authority and Prime Designer to discuss and develop mutual understandings relative to administration of the quality assurance program, safety program, labor provisions, the schedule of work, and other Contract procedures.

ARTICLE 5
SUBCONTRACTORS

5.1 DEFINITION

5.1.1 A Subcontractor is a person or entity who has a direct contract with the Contractor to perform a portion of the work at the site.

5.1.2 The Contractor shall require each Subcontractor to be bound to the Contractor by the terms of the Contract Documents, and to assume toward the Contractor all the obligations and responsibilities which the Contractor assumes toward the Awarding Authority and the Prime Designer.

5.1.3 Subcontracts between the Contractor and a filed sub-bidder shall be in the form required by M.G.L c.149 §44F.

5.2 CONTINGENT ASSIGNMENT OF SUBCONTRACTS

Each subcontract agreement for a portion of the Work is assigned by the Contractor to the Awarding Authority provided that:

.1 assignment is effective only after termination of the Contract by the Awarding Authority for cause pursuant to Paragraph 17.1 and only for those subcontract agreements which the Awarding Authority accepts by notifying the Subcontractor in writing; and

.2 assignment is subject to the prior rights of the surety obligated under bond relating to the Contract.

ARTICLE 6
CONSTRUCTION BY AWARDING AUTHORITY OR BY SEPARATE CONTRACTORS

6.1 AWARDING AUTHORITY'S RIGHT TO PERFORM CONSTRUCTION AND TO AWARD SEPARATE CONTRACTS

6.1.1 The Awarding Authority reserves the right to perform construction or operations related to the Project with the Awarding Authority's own forces, and to award separate contracts in connection with other portions of the Project or other construction or operations on the site. If the Contractor claims that delay or additional cost is involved because of such action by the Awarding Authority, the Contractor shall make such claim as provided elsewhere in the Contract Documents.

6.1.2 The Awarding Authority shall provide for coordination of the activities of the Awarding Authority's own forces and of each separate contractor with the Work of the Contractor, who shall cooperate with them. The Contractor shall participate with other separate contractors and the Awarding Authority in reviewing and coordinating their construction schedules with one another when directed to do so.

6.2 MUTUAL RESPONSIBILITY

6.2.1 The Contractor shall afford the Awarding Authority and separate contractors reasonable opportunity for introduction and storage of their materials and equipment and performance of their activities and shall connect and coordinate the Contractor's construction and operations with theirs as required by the Contract Documents.

6.2.2 If part of the Contractor's Work depends on proper execution or results upon construction or operations by the Awarding Authority or a separate contractor, the Contractor shall, prior to proceeding with that portion of the Work, promptly report to the Prime Designer apparent discrepancies or defects in such other construction that would render it unsuitable for such proper execution and results. Failure of the Contractor to so report shall constitute an acknowledgment that the Awarding Authority's or separate contractors' completed or partially completed construction is fit and proper to receive the Contractor's Work, except as to defects not then reasonably discoverable.

6.2.3 The Contractor shall promptly remedy damage wrongfully caused by the Contractor to completed or partially completed construction or to property of the Awarding Authority or separate contractors

ARTICLE 7
CHANGES IN THE WORK

7.1 CHANGES - DEFINITIONS

7.1.1 All changes in the work, including any increase, decrease, or other equitable adjustment in the Contract Sum or in the time for performing the Contract, shall be authorized in the form of one, or a combination of, the following written instruments: Change Order, Construction Change Directive, or a Minor Change in the Work. The term "equitable adjustment" as used in this paragraph shall include all

adjustments to the Contract Sum or time to which the Contractor is entitled pursuant to M.G.L. c.30 §§39N and 39O and such equitable adjustment shall be made in accordance with the provisions of this Article.

7.1.2 A Minor Change is a written order binding on the Awarding Authority and Contractor issued by the Prime Designer, with the concurrence of the Construction Advisor, not involving adjustment in the Contract Sum or extension of the Contract Time and not inconsistent with the intent of the Contract Documents. The Contractor shall carry out such written orders promptly.

7.1.3 A Change Order is a written instrument prepared by the Prime Designer and signed by the Awarding Authority, Contractor, and Prime Designer, stating their agreement regarding a change in the work, including a change in the Contract Sum or Contract Time.

7.1.4 A Construction Change Directive is a written order prepared by the Prime Designer and signed by the Awarding Authority and Prime Designer directing a change in the Work and stating a proposed basis for adjustment, if any, in the Contract Sum, or Contract Time, or both. The Awarding Authority may, by Construction Change Directive, and without invalidating the Contract, order changes in the Work within the general scope of the Contract consisting of additions, deletions or other revisions, the Contract Sum and Contract Time being adjusted accordingly.

7.1.5 A Change Order shall be based upon agreement among the Awarding Authority, Contractor and Prime Designer; a Construction Change Directive requires agreement by the Awarding Authority and Prime Designer may or may not be agreed to by the Contractor; an order for a Minor Change in the Work may be issued by the Prime Designer with the concurrence of the Awarding Authority.

7.2 REQUEST FOR A CHANGE IN THE WORK

A change order request shall be in writing and may originate with the Awarding Authority, the Prime Designer or the Contractor. If such a request would cause a change in the Contract Sum, the Contractor shall promptly submit to the Prime Designer its cost and pricing data for such proposed change. Such data shall be accurate, current and complete at the time of submission and shall be computed in accordance with Subparagraph 7.3.1.

7.3 METHOD FOR DETERMINING AMOUNT OF CHANGE

7.3.1 Changes in the Contract Sum shall be calculated in accordance with one or a combination of the following methods, as determined by the Prime Designer:

- **.1** Lump sum basis, provided the lump sum amount shall include the estimated cost of the change, broken down by Items **a** through **i** in the following Subparagraph **.3.**
- **.2** Unit price basis, to be adjusted in accordance with contract unit prices, or other agreed upon unit prices provided that the unit prices shall be inclusive of all costs related to such equitable adjustment.
- **.3** Time and materials basis, on a not-to-exceed predetermined upset amount determined by the Prime Designer, to be subsequently adjusted on the basis of the Contractor's actual costs based on the following items **a** though **i**:
  - **a.** Cost of labor at the rates found elsewhere in this document, including foremen;
  - **b.** Costs of materials, supplies and equipment, including cost of transportation, whether incorporated or consumed;
  - **c.** Rental cost of machinery and equipment, exclusive of hand tools, whether rented from the Contractor or others.
  - **d.** A percent of the net increase or decrease of Item **a** to cover Worker's Compensation, F.I.C.A., and unemployment contributions.
  - **e.** The percentage for Worker's Compensation in Item **d** above shall not exceed the standard manual rate for the involved trade, as set by the Worker's Compensation Rating and Inspection Bureau of Massachusetts. This rate shall not include any surcharges such as experience modifications and all risk factor adjustment programs, etc.

f. For work performed by the Contractor's own forces, there shall be added an amount of 15% of items **a - d** for overhead, superintendence, and profit.

g. For work performed by any Subcontractor, there shall be added an amount of 15% of the Subcontractor's costs for Items **a - d** for the Subcontractor's overhead, superintendence and profit. The Contractor shall be entitled to an additional 10% mark-up on the total amount of the Subcontractor's price as compensation for assuming full responsibility and supervision for the Subcontractor's work.

h. Actual increases in the premium costs for performance and payment bonds required of the Contractor and filed Subcontractors, provided there will be an appropriate credit for reduced premiums for a credit change order.

i. On any change in the Contract Sum that involves a credit, the amount of the credit will not include an overhead and profit factor, however, the credit will include an amount for item **d**. which shall not be less than 25% of item **a**.

7.3.2 The method provided in Subparagraph 7.3.1, for compensating the Contractor and Subcontractors for changes in the Work, shall be considered to adequately compensate the Contractor and Subcontractors for any and all costs directly, indirectly, or consequentially related to, or caused by, such change in the work.

7.4 WORK PERFORMED UNDER PROTEST

The Contractor shall perform all work as directed by the Prime Designer, and if the Prime Designer determines that certain work for which the Contractor has requested a change order does not represent a change in the Contract, or if the Contractor and the Prime Designer cannot agree to the amount of compensation for a change order, the Contractor shall perform said work under protest and must follow the notice requirements and maintain the records required by Subparagraph 7.7.3.

7.5 STATUTORY CHANGE ORDER PROVISIONS

The Contractor's attention is directed to the Massachusetts General Laws Chapter 30, §§ 39I, 39J, 39N, 39O and 39P, the provisions of which apply to this Contract.

7.6 DIFFERING SITE CONDITIONS, M.G.L. c.30 §39N

7.6.1 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 Awarding Authority may request an appropriate time extension and an equitable adjustment in the Contract Sum 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 within 7 calendar days after such conditions are discovered. Otherwise, the party waives its rights to the claim.

7.6.2 Upon receipt of such a claim from a Contractor, or upon its own initiative, the Awarding 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 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 Awarding Authority shall upon submission by the Contractor of a properly submitted Change Order request, make an equitable adjustment in the Contract Sum and the Contract shall be modified in writing accordingly.

7.6.3 TIMELY DECISION BY AWARDING AUTHORITY. M.G.L. c.30 §39P

Whenever this Contract requires the Awarding Authority or its Prime Designer to make a decision during construction of the Project, on interpretation of the specifications, approval of equipment, material or any other approval, or progress of the work, that decision shall be made promptly and, in any event, no later

than thirty (30) days after receipt of a written submission for such decision by the Contractor; but if such decision requires extended investigation and study, the Awarding Authority or the Prime Designer shall, within thirty days after the receipt of the submission, give the Contractor written notice of the reasons why the decision cannot be made within the thirty day period and the date by which the decision will be made.

7.7 CLAIMS

7.7.1 If the Contractor has any claim or dispute of any nature arising under this Contract, including a claim based on the Awarding Authority's failure or refusal to approve a change order request of the Contractor, in full or in part, the Contractor shall submit such claim or dispute to the Prime Designer, in the form of a change order request, for initial review and consideration, subject to further appeal to the Administrator. If the Contractor is not satisfied with the Prime Designer's decision or, if the Prime Designer fails to render a decision within thirty days after receiving written notice of such claim or dispute from the Contractor, the Contractor may file a written request for a decision with the Awarding Authority's Contract Officer pursuant to Subparagraph 7.7.2.

7.7.2 Appeal of an Prime Designer's decision under Subparagraph 7.7.1 must be made directly to Awarding Authority's authorized signatory by certified mail, copy to the Prime Designer and Awarding Authority, within twenty-one (21) calendar days after the date on which the party making the appeal receives the Prime Designer's written decision or within twenty-one (21) days after the thirty (30) day non-decision period noted in 8.7.1. Failure to appeal within this period will result in the Prime Designer's decision becoming final and binding upon the Awarding Authority and the Contractor.

7.7.3 Pending resolution of the claim or dispute, the Contractor must proceed with the disputed Work, as directed by the Prime Designer. The Contractor must give written notice to the Awarding Authority and the Prime Designer stating that it is proceeding with the disputed work under protest. Accurate records of the nature and extent of the disputed Work and of the time spent and equipment used on the disputed Work shall be maintained by the superintendent and verified daily by the Project Representative, or the Awarding Authority's designee. Failure of the Contractor to maintain such records shall cause the Contractor to forfeit its claim to additional compensation for such disputed work.

7.7.4 Meetings or administrative conferences held by the Awarding Authority's authorized signatory to review the basis of the claim or dispute are not subject to the State Administrative Procedures Act.

7.7.5 At the conclusion of these proceedings, the Awarding Authority's Contract Officer shall issue a decision that shall be final under the Contract. The matter may then be appealed to a court of competent jurisdiction.

7.7.6 Requests for administrative conferences by subcontractors must be made by the Contractor; subcontractors cannot make such requests directly.

ARTICLE 8
TIME, SCHEDULES, AND COMPLETION

8.1 DEFINITIONS

8.1.1 Unless otherwise provided, Contract Time is the period of time, as extended by approved Change Order, allotted in the Contract Documents for Substantial Completion of the Work.

8.1.2 The date of commencement of the Work is the date established in the Notice to Proceed from the Awarding Authority. The commencement date shall not be postponed by the failure to act by the Contractor or by persons or entities for whom the Contractor is responsible.

8.1.3 The date of Substantial Completion is the date certified by the Prime Designer in accordance with Subparagraph 8.6.7.

8.1.4 The term "day" as used in the Contract Documents shall mean calendar day unless otherwise specifically defined.

8.2. PROGRESS AND COMPLETION

8.2.1 Time limits stated in the Contract Documents are of the essence of the Contract. By executing the Contract the Contractor confirms that the Contract Time is a reasonable period for performing the Work.

8.2.2 The Contractor shall proceed expeditiously with adequate forces and shall achieve Completion within the Contract Time.

8.3 DELAYS AND EXTENSIONS OF TIME

8.3.1 The Contractor shall be entitled to an extension of time for completion of the Work because of;

- **.1** acts of God;
- **.2** labor disputes;
- **.3** abnormal weather conditions; or
- **.4** acts of neglect of the Awarding Authority and the Prime Designer as described in Subparagraph 7.6.3.

8.3.1.5 Except in unusual circumstances, delays caused by suppliers, Subcontractors and sub-subcontractors shall be considered to be within the control of the Contractor.

8.3.1.6 Should the Contractor require additional time to complete the Work, the Contractor shall document the reasons therefore and request an extension of time at the time the alleged delay occurs, as provided in this Article and Article 7.

8.3.1.7 Failure to notify the Prime Designer of any delay as provided in this Article shall preclude the Contractor from subsequently claiming any damages due to said delay.

8.3.1.8 Requests for extensions of time shall be submitted as a change order request to the Prime Designer under Article 7 for the Awarding Authority's consideration.

8.3.2 CONTRACTOR'S LIABILITY FOR DELAYS

The Contractor shall be liable for, and shall pay, to the Awarding Authority, all of the Awarding Authority's Project related costs incurred after the time stipulated for Substantial Completion, as extended by Change Order. Such costs shall include: fees paid to the Prime Designer as extra services for inspection services and administration of the Contract, at the rate stipulated in the Contract for l Design Services between the Awarding Authority and the Prime Designer; the costs of the Project Representative at the current salary rate; lost rental income based on the average rent collected by the Awarding Authority, and/or increased rental subsidies and any other direct expenses. The Awarding Authority may retain from moneys otherwise due the Contractor whatever sums accrue to the Awarding Authority pursuant to this provision. The Contractor shall not be liable for costs for delay in performance for any period for which an extension of the Contract Time has been granted pursuant to the provisions of Subparagraph 8.3. If the Awarding Authority does not calculate the direct costs for the delay, the Contractor shall be assessed $500/day for delays as a result of the Contractor's actions.

8.3.3 AWARDING AUTHORITY DELAYS

8.3.3.1 The Awarding Authority may delay the commencement of the Work, or any part thereof, due to unforeseen circumstances or conditions which have a bearing on the Work required under this Contract or for any other reason if it is deemed to be in the best interest of the Awarding Authority to do so. Except as expressly provided in the following Subparagraphs 8.3.3.2, 8.3.3.3, and 8.3.3.4, the Contractor shall have no claim for additional compensation on account of such delay, but shall be entitled to an extension of Contract Time as determined reasonable by the Prime Designer.

8.3.3.2 The Contractor and the Awarding Authority agree that the following Subparagraphs provide the Contractor with the right to request additional compensation for Awarding Authority caused delays only in the following two circumstances:

- **.1** When the Awarding Authority provides the Contractor with a written order to suspend or delay the Work, or a portion thereof, for a period of fifteen days or more.
- **.2** When the Awarding Authority or its Prime Designer fails to make a decision within the thirty day period described in Subparagraph 7.6.3 and such failure delays the Work, or a portion thereof, for fifteen days or more.

8.3.3.3 The Awarding Authority may, for its convenience, order the Contractor in writing to suspend, delay, or interrupt all or any part of the Work for such period of time as it may determine appropriate, provided however, that if there is a suspension, delay, or interruption for fifteen days or more, or there is 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 Sum for any increase in the cost of performance of this Contract, but shall not include any profit to the Contractor on account of such increase; and provided further, that the Awarding Authority shall not make any adjustment in the Contract Sum 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 Sum under any other Contract provisions. M.G.L. c.30 §39O (a).

8.3.3.4 The Contractor must submit the amount of a claim under Subparagraph 8.3.3.3 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 Contractor notified the Awarding Authority in writing of the act or failure to act involved in the claim. M.G.L. c.30 §39O (b).

8.3.3.5 The Awarding Authority and the Contractor agree that the preceding Subparagraph 8.3.3.4 places a burden on the Contractor to inform the Awarding Authority, whenever the Contractor considers that an action or inaction of the Awarding Authority or its Prime Designer could result or has resulted in a delay in the Project, thereby providing the Awarding Authority with the opportunity to take action to avoid or lessen the time extensions or damages that might be associated with such action or inaction.

8.3.3.6 The Contractor must file any claim for additional compensation made pursuant to Subparagraph 8.3.3.4 as a Change Order request. The amount of any such claim shall be calculated only in accordance with the provisions of Subparagraph 7.3.1.3 items a through i, and shall be subject to the provisions of Subparagraph 7.3.2.

8.4 CONSTRUCTION AND PAYMENT SCHEDULES

8.4.1 Prior to commencement of the Work, the Contractor shall submit to the Prime Designer a construction schedule in bar graph form or other format, satisfactory to the Prime Designer, showing in detail the proposed progress for the construction of the various parts of the Work, the proposed times for receiving materials required, and the interrelationship between the various construction operations and the percentage of completion and the dollar value of the completed work on the first day of each month for each section of the specifications and the entire Work. Submission of said schedule shall be a condition precedent to approval of the Contractor's first application for payment.

8.4.2 At the end of each month, or more often if required, the Contractor shall furnish the Prime Designer an updated schedule showing actual progress of the various parts of the Work in comparison with the originally proposed progress and payment schedules. If the Prime Designer raises any objections to progress or payment schedules submitted by the Contractor, the Contractor shall immediately address and resolve such objections to the reasonable satisfaction of the Prime Designer.

8.4.3 If the Contractor submits a construction schedule that anticipates Substantial Completion before the date established in the Awarding Authority's Notice to Proceed, the Contractor shall have no claim for additional compensation on account of any delays that prevent Substantial Completion before the date set in said Awarding Authority's Notice to Proceed.

8.5 USE AND OCCUPANCY

8.5.1 Prior to the date of Substantial Completion of the entire Project stipulated in the Notice to Proceed, the Awarding Authority shall have the right, from time to time, to occupy and use any portion of the Project as the Work in connection therewith is substantially completed, provided such use and occupancy does not unduly interfere with the Contractor's operations.

8.5.2 The Prime Designer will, prior to any such use and occupancy, give fourteen (14) days written notice to the Contractor, indicating the areas intended to be occupied and used, and the intended commencement date of such use and occupancy. Occupancy and use shall not commence prior to a time mutually agreed to by the Awarding Authority and the Contractor.

8.5.3 Upon receipt of such notice of intent, the Contractor shall promptly secure and submit to the Prime Designer endorsement from the insurance carrier and the building inspector having jurisdiction over the Work, permitting use and occupancy of the Work, or any designated portion thereof, by the Awarding Authority prior to Substantial Completion of the entire Project. The Contractor shall be permitted to cancel its special perils insurance for that portion of the Project used and/or occupied by the Awarding Authority.

8.5.4 Partial or entire use and occupancy by the Awarding Authority shall not constitute an acceptance of Work not completed in accordance with the Contract Documents nor relieve the Contractor from the obligation of performing any Work required by the Contract but not completed at the time of use and occupancy. Before such use and occupancy, the Prime Designer will give the Contractor a list of items to be completed prior to Final Completion occurring in the areas to be occupied.

8.5.5 The Contractor shall be relieved of all maintenance costs of the portion of the Project occupied under the provisions of this Article.

8.5.6 The Contractor shall not be responsible for wear and tear or damage resulting solely from such use and occupancy.

8.5.7 The Contract Sum will be adjusted by mutually acceptable arrangements between the Awarding Authority and the Contractor with respect to heat, electricity, and water furnished by the Contractor to the portion of the Work so occupied.

8.5.8 When any portion of the building is in condition to receive fittings, appliances, furniture or other property to be furnished and installed by the Awarding Authority under separate contracts, the Contractor shall allow the Awarding Authority to bring such items into the building and shall provide all reasonable facilities and protection therefore.

8.6 SUBSTANTIAL COMPLETION

8.6.1 Substantial Completion is the stage in the progress of the Work when, in the opinion of the Prime Designer, the Work is sufficiently complete in accordance with the Contract Documents so the Awarding Authority can occupy or utilize the Work for its intended use.

8.6.2 When the Contractor considers that the Work, or a portion thereof which the Awarding Authority agrees to accept separately, is substantially complete, the Contractor shall prepare and submit to the Prime Designer a comprehensive list of items to be completed or corrected. The Contractor shall proceed promptly to complete and correct items on the list. Failure to include an item on such list does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract Documents.

8.6.3 Upon receipt of the Contractor's list of items to be completed or corrected, the Prime Designer will promptly make a thorough inspection and prepare a "punch list", setting forth in accurate detail any items on the Contractor's list and additional items that are not acceptable or are incomplete.

8.6.4 If, after receipt of the Contractor's list, the Prime Designer determines that the Work is not substantially complete, the Prime Designer shall inform the Contractor of those items that must be completed before the Prime Designer will prepare a punch list. Upon completion of those items, the Contractor shall again request the Prime Designer to prepare the punch list.

8.6.5 When the punch list has been prepared, the Contractor will arrange a meeting with the Prime Designer and Subcontractors to identify and explain all punch list items and address questions on the work that must be done before final acceptance.

8.6.6 The Prime Designer may revise the punch list, from time to time, to ensure that all items of the Work are properly completed.

8.6.7 The Prime Designer will prepare a Certificate of Substantial Completion which shall establish the date of Substantial Completion, shall establish responsibilities of the Awarding Authority and Contractor for security, maintenance, heat, utilities, damage to the Work and insurance and shall fix the time within which the Contractor shall finish all items on the list accompanying the Certificate within the provisions of Subparagraph 8.7.2.

8.6.8 Warranties required by the Contract Documents shall commence on the date of Substantial Completion of the Work or designated portion thereof unless otherwise provided in the Certificate of Substantial Completion. The Certificate of Substantial Completion shall be submitted to the Awarding Authority and Contractor for their written acceptance of responsibilities assigned to them in such Certificate.

8.6.9 Partial Payment of retainage shall not be made until at least 45 days after the effective date of the Certificate of Substantial Completion.

8.7 FINAL COMPLETION

8.7.1 After the Prime Designer has certified that the Work is substantially complete, the Contractor shall immediately proceed to complete all the remaining items of Work as determined by the Prime Designer, including items authorized by Change Orders, Construction Change Directives or items disputed by the Contractor.

8.7.2 The Contractor shall complete all the remaining items of Work described in Subparagraph 8.7.1, as soon as possible, and in any event within sixty (60) days after Substantial Completion, unless the Prime Designer determines that a shorter time period for completion is appropriate, in which event the Contractor must complete the Contract work within such period. The Prime Designer may extend such sixty (60) day period if the Prime Designer determines that such extension is justified. Upon completion of

the Work, the Contractor shall notify the Prime Designer in writing that all the Work is complete. Within seven (7) days, the Prime Designer will inspect the Work to determine its completeness. If the Prime Designer determines the Work is complete, then the Prime Designer will prepare a Certificated of Final Completion. Otherwise, the Prime Designer will notify the Contractor in writing of the incomplete Work.

8.7.3 If the Contractor fails to complete the remaining items of Work within the time period provided in Subparagraph 8.7.2, the Prime Designer will prepare a written monetized punchlist of the outstanding Work to be completed. The Contractor will have seven (7) calendar days to complete the Work or notify the Prime Designer and Awarding Authority in writing why the Work cannot be completed in seven (7) days and include a proposed schedule to complete the Work. If the Contractor fails to comply with this provision, the Awarding Authority may arrange for other contractors to complete such items and the direct and indirect costs of such completion shall be charged against the balance due the Contractor or, if no such balance remains, the Contractor shall pay the Awarding Authority the costs of such completion.

8.7.4 As an alternative to the procedure described in Subparagraph 8.7.3, the Awarding Authority may invoke the performance bond of the Contractor and demand that the surety shall complete the remaining items of Work in a timely manner.

8.7.5 The Prime Designer will conduct up to two (2) inspections of completed punch list items. The Contractor shall be responsible for the costs of additional inspections required to verify successful completion of the punch list.

ARTICLE 9
PAYMENTS

9.1 CONTRACT SUM

The Contract Sum is stated in the Awarding Authority-Contractor Agreement and, including authorized adjustments, is the total amount payable by the Awarding Authority to the Contractor for performance of the Work under the Contract Documents.

9.2 SCHEDULE OF VALUES

9.2.1 Before the first Application for Payment, the Contractor shall submit to the Prime Designer a schedule of values allocated to various portions of the Work, prepared in such form and supported by such data to substantiate its accuracy as the Prime Designer may require. This schedule, unless objected to by the Prime Designer, shall be used as a basis for reviewing the Contractor's Applications for Payment.

9.2.2 The schedule of values shall contain a separate item for each Section of the Specifications broken down in such form as the Prime Designer may require. Each item in the schedule of values shall include its proper share of overhead and profit.

9.2.2.1 The Schedule of Values shall be arranged in vertical columns identified with titles, including Line Item Number, Description of Work, Scheduled Value, Work Completed (From Previous Application and This Period), Materials Presently Stored, Total Completed and Stored to Date, Percentage, Balance to Finish and Retainage (5%). The Schedule of Values shall be updated showing the status of work covered by approved Change Orders. The Schedule of Values may be revised if later found by the Prime Designer to be inaccurate.

9.2.2.2 For each line item which has installed value of more than $20,000, breakdown the costs to list major products, components, or operations under each line.

9.2.2.3 The sum of costs of all items listed in Schedule of Values shall be equal to total Contract Sum.

9.2.2.4 Work Covered in Division 1: Itemize separate line item cost for each of the following general cost items (if applicable):

- **a.** Insurance.
- **b.** Performance and Payment Bonds.
- **c.** Supervision and Project Management.
- **d.** Submittals Preparation.
- **e.** Protection.
- **f.** Temporary facilities.
- **g.** Project sign.
- **h.** Construction waste management.
- **i.** Final cleaning.
- **j.** Punchlist and Close-out Documents.
- **k.** Commissioning activities (if applicable).
- **l.** Other items of Work as requested by the Prime Designer or Awarding Authority.

9.3 APPLICATIONS FOR PAYMENT

Once each month, on a date established at the beginning of the Work, the Contractor shall deliver to the Prime Designer by hand or by registered or certified mail with return receipt, an itemized Application for Payment, supported by such data substantiating the Contractor's right to payment as the Prime Designer may require, and reflecting retainage as provided in Subparagraph 9.6.1. Such Application for Payment shall be submitted on a form available from the Awarding Authority. The form shall show separately:

- **.1** The value of labor and materials incorporated in the Work.
- **.2** The value, kind, and quantity of each item of material or equipment not incorporated in the Work but delivered and suitably stored at the site, during the current pay period.
- **.3** The value, kind, and quantity of each item of material or equipment not incorporated in the Work but suitably stored at some other location agreed upon in writing, during the current pay period.
- **.4** All Change Orders approved up to the date of the Application for Payment.
- **.5** The amounts approved for payment for each item on previous applications.

9.4 PAYMENT FOR STORED MATERIALS

9.4.1 The Contractor shall include in such Application for Payment only such materials as are incorporated in the Work. Except however, the Contractor may include the value of materials or equipment delivered at the site of the Work (or at some location within Massachusetts agreed to in writing) upon delivery to the Awarding Authority of:

- **.1** an acceptable Transfer of Title; and
- **.2** receipted invoices or other acceptable proof of prior payment by the Contractor for such materials; and
- **.3** a stored materials insurance binder (see subparagraph 14.5.2) that covers the materials for which payment is requested, that name of the Awarding Authority as an insured party should the stored materials be subjected to any casualty, loss, or theft prior to their inclusion in the Work.

9.4.2 This material(s) or equipment must, in the judgment of the Prime Designer:

- **.1** meet the requirements of the Contract, including prior shop drawing, product data, and sample approval; and
- **.2** be ready for use; and
- **.3** be properly stored by the Contractor and adequately protected until incorporated into the Work.

9.4.3 Failure to comply with subparagraphs 9.4.1 and 9.4.2 may result in Certificates being changed in accordance with M.G.L. c.30 §39K.

9.5. CERTIFICATES FOR PAYMENT

9.5.1 The Prime Designer shall mark the date of receipt on the Contractor's Application for Payment. The Prime Designer will, within seven (7) days after receipt of the Contractor's Application for Payment either,

- **.1** issue to the Awarding Authority a Certificate for Payment, with a copy to the Contractor, for such amount as the Prime Designer determines is properly due, or
- **.2** return the application to the Contractor if it is not in proper form or contains computations not arithmetically correct; or
- **.3** make changes to the application as provided in subparagraph 9.5.2.

9.5.2 The Prime Designer shall notify the Contractor and Awarding Authority in writing of the Prime Designer's reasons for withholding certification in whole or in part as provided in subparagraphs 9.6.1.2 and 9.6.1.3.

9.5.3 The Awarding Authority may make changes in any Application for Payment submitted by the Contractor in accordance with M.G.L. c.30 §39K, and the payment due on said Application for Payment shall be computed in accordance with the changes so made. The provisions of said Section 39K shall govern payments pursuant to Applications for Payment on which the Awarding Authority has made changes.

9.5.4 No certificate for payment nor any progress payment shall constitute acceptance of Work not in accordance with the Contract Documents.

9.6 STATUTORY PAYMENT PROVISIONS

9.6.1 After the Prime Designer has issued a Certificate for Payment the Awarding Authority shall make payment to the Contractor in accordance with M.G.L. c.30 §39K and as amended which provides as follows:

- **.1** Within 30 days after receipt from the Contractor, at the place designated by the Awarding Authority if such a place is so designated, of a periodic estimate requesting payment of the amount due for the preceding month, the Awarding Authority will make a periodic payment to the Contractor for the Work performed during the preceding month and for the materials not incorporated in the Work but delivered and suitably stored at the site (or at some location agreed upon in writing) to which the Contractor has title or to which a Subcontractor has title and has authorized the Contractor to transfer title to the Awarding Authority, less (1) a retention based on its estimate of the fair value of its claims against the Contractor and less (2) a retention for direct payments to Subcontractors based on demands for same in accordance with the provisions of Section 39F, and less (3) a retention not exceeding five percent (5%) of the approved amount of the periodic payment.
- **.2** After the receipt of a periodic estimate requesting final payment and within 65 days after (a) the Contractor fully completes the Work or substantially completes the work so that the value of the Work remaining to be done is, in the estimate of the Awarding Authority, less than one percent (1%) of the original Contract Sum, or (b) the Contractor substantially completes the Work and the Awarding Authority takes possession for occupancy, whichever occurs first, the Awarding Authority shall pay the Contractor the entire balance due on the Contract less, (1) a retention based on its estimate of the fair value of its claims against the Contractor and of the cost of completing the incomplete and unsatisfactory items of Work less (2) a retention for direct payments to Subcontractors based on demands for same in accordance with the provisions of Section 39F, or based on the record of payments by the Contractor to the Subcontractors under this Contract if such record of payment indicates that the Contractor has not paid Subcontractors as provided in Section 39F.
- **.3** If the Awarding Authority fails to make payment as herein provided, there shall be added to each such payment daily interest at the rate of three percentage points above the rediscount rate then charged by the Federal Reserve Bank of Boston commencing on the first day after said payment is due and continuing until the payment is delivered or mailed to the Contractor; provided, that no interest shall be due, in any event, on the amount due on a periodic estimate for final payment until forty-five days after receipt of such a periodic estimate from the Contractor, at the place designated by the Awarding

Authority if such a place is so designated. The Contractor agrees to pay to each Subcontractor a portion of any such interest paid in accordance with the amount due each Subcontractor.

9.6.2 DIRECT PAYMENT TO SUBCONTRACTORS

9.6.2.1 The Contractor shall make payments to filed Subcontractors in accordance with M.G.L c.30 §39F that provides as follows:

.1 Forthwith after the Contractor receives payment on account of a periodic estimate, the Contractor shall pay to each Subcontractor the amount paid for the labor performed and the materials furnished by the Subcontractor, less any amount specified in any court proceedings barring such payment and also less any amount claimed due from the Subcontractor by the Contractor.

.2 Not later than the 65th day after each Subcontractor substantially completes the 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 Contractor. The 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 Contractor.

.3 Each payment made by the Awarding Authority to the Contractor pursuant to Subparagraphs .1 and .2 of this paragraph for the labor performed and the materials furnished by a Subcontractor shall be made to the Contractor for the account of that Subcontractor and the Awarding Authority shall take reasonable steps to compel the 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 Contractor or which is to be included in a payment to the Contractor for payment to the Subcontractor as provided in Subparagraphs .1 and .2, the Awarding Authority shall act upon the demand as provided in this section.

.4 If, within 70 days after the Subcontractor has substantially completed the Subcontract Work, the Subcontractor has not received from the Contractor the balance due under the Subcontract including any amount due for extra labor and materials furnished to the 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 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 a copy to the Contractor, the 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 Contractor and of the amount due for each claim made by the Contractor and of the amount due for each claim made by the Contractor against the Subcontractor.

.5 Within 15 days after receipt of the demand by the Awarding Authority but in no event prior to the 70th 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 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 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 .4. 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 part (i) and (ii) of this Subparagraph.

.6 The Awarding Authority shall forthwith deposit the amount deducted from a direct payment as provided in part (iii) of Subparagraph .5 in an interest-bearing joint account in the names of the Contractor and the Subcontractor in a bank in Massachusetts selected by the Awarding Authority or agreed upon by the Contractor and the Subcontractor and shall notify the 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 Contractor and the Subcontractor or as determined by decree of a court of competent jurisdiction.

.7 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 .6 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 or out of amounts which later become payable to the Contractor and in order of receipt of such demands from Subcontractors. All direct payments shall discharge the obligation of the Awarding Authority to the Contractor to the extent of such payment.

.8 The Awarding Authority shall deduct from payments to the Contractor amounts which, together with the deposits in interest-bearing accounts pursuant to Subparagraph .6, 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 to such deductions prior to any claims against such amounts by creditors of the Contractor.

.9 If the Subcontractor does not receive payment as provided in Subparagraph .1 or if the Contractor does not submit a periodic estimate for the value of the labor and 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 .1, the Subcontractor may demand direct payment by following the procedure in Subparagraph .4 and the 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 Contractor. Thereafter the Awarding Authority shall proceed as provided in Subparagraphs .5, .6, .7, and .8.

9.7 FINAL PAYMENT

9.7.1 Upon final acceptance of the Work, the Contractor shall be entitled to payment of the Contract balance, in accordance with Subparagraph 9.6.1.2 and per the process described in Division 1 of the Specifications.

9.7.2 The acceptance by the Contractor of the last payment due under this Contract or the execution of the Final Certificate of Completion, shall operate as a release to the Awarding Authority and the Prime Designer from all claims and liability related to this Contract.

9.8 PAYMENT LIABILITIES OF CONTRACTOR

9.8.1 The Contractor shall be responsible to the Awarding Authority for all expenses, losses, and damages incurred in consequence of any defect, omission, or mistake of the Contractor or any of its employees, Subcontractors, or suppliers.

9.8.2 The Awarding Authority may retain any moneys which would otherwise be payable under this Contract and apply the same, or so much as may be necessary therefore, to the payment of any expenses, losses, or damages incurred by the Awarding Authority as a direct result of the Contractor's failure to perform its obligations hereunder.

ARTICLE 10
GUARANTEES AND WARRANTIES

10.1 GENERAL GUARANTY

If at any time during the period of one (1) year from the date of Substantial Completion as defined in Paragraph 8.6, any part of the Work shall, in the reasonable determination of the Prime Designer or Awarding Authority, require replacing or repairing due to the fact that it is broken, defective, or otherwise

does not conform to the Contract Documents, the Awarding Authority will notify the Contractor to make the required repairs or replacement.

10.2 If the Contractor shall neglect to commence such repairs or replacement to the satisfaction of the Awarding Authority within ten (10) days from the date of giving or mailing such notice, then the Awarding Authority may employ other persons to make the same.

10.3 The Contractor agrees, upon demand, to pay to the Awarding Authority all amounts that the Awarding Authority expends for such repairs or replacements.

10.4 During this one-year guarantee period any corrective work shall be performed in accordance with the applicable terms of this Contract. For items of work completed after use and occupancy has been taken, the one year guarantee shall commence at the time the Awarding Authority accepts such items.

10.5 This one-year guarantee shall not limit any express guaranty or warranty provided elsewhere in the Contract.

10.6 SPECIAL GUARANTEES AND WARRANTIES

10.6.1 Guarantees and warranties required in the various sections of the Specifications must be delivered to the Prime Designer before final payment to the Contractor may be made, or in the case of guarantees and warranties which originate with a Subcontractor's section of the Work, before final payment for the amount of that subtrade or for the phase of Work to which the guarantee or warranty relates.

10.6.2 The failure to deliver a required guarantee or warranty shall constitute a failure to fully complete the Work in accordance with the Contract Documents.

10.6.3 The Contractor's obligation to correct Work as set forth in Paragraph 3.12 is in addition to, and not in substitution of, such guarantees or warranties as may be required in the various Sections of the Specifications.

ARTICLE 11
MISCELLANEOUS LEGAL REQUIREMENTS

11.1 GENERAL

The Contractor shall stay fully informed of all existing and future state and national laws and municipal ordinances and regulations in any manner affecting those engaged or employed in the work, or the materials used or employed in the work, or in any way affecting the conduct of the Work, and of all such orders and decrees of bodies or tribunals having any jurisdiction or authority over the Contract Work. All provisions of law that apply to this Contract are hereby made a part of this Contract. If any discrepancy or inconsistency is discovered in the Contract Documents in relation to any such law, ordinance, regulation, order or decree, the Contractor shall forthwith report the same to the Awarding Authority in writing.

11.1.1 The Contractor shall cause all of its agents and employees to observe and comply with all such existing and future laws, ordinances, regulations, orders and decrees.

11.2 CORPORATE DISCLOSURES

The Contractor, if a foreign corporation, shall comply with M.G.L. c.181 §3 and §5, and M.G.L. c.30 §39L.

11.3 VETERANS PREFERENCE

In the employment of mechanics and apprentices, teamsters, chauffeurs, and laborers in the construction of public works in the Commonwealth, preference shall first be given to citizens of the Commonwealth who have been residents of the Commonwealth for at least six months at the commencement of their employment and who are veterans as defined M.G.L. c.4 §7 (34), and who are qualified to perform the work to which the employment relates; and secondly, to citizens of the Commonwealth generally who have been residents of the Commonwealth for at least six months at the commencement of their employment, and if they cannot be obtained in sufficient numbers, then to citizens of the United States.

11.4 PREVAILING WAGE RATES

The Director of the Department of Labor and Workforce Development has established the Schedule found in Division One of the Specifications, listing the prevailing minimum wage rates that must be paid to all workers employed on the Contract. Such Schedule shall continue to be the minimum rate of wages payable to workers on this Contract throughout the term of the Contract. The Contractor shall not have any claim for extra compensation from the Awarding Authority if the actual wages paid to employees on the Contract exceeds the rates listed on the Schedule. The Contractor shall cause a copy of said Schedule to be kept in a conspicuous place at the Project site during the term of the Contract. (See M.G.L c.149 §26-27H.) If reserve police officers are employed by the Contractor, they shall be paid the prevailing wage of regular police officers. (See M.G.L c.149 §34B).

11.4.1 The Contractor shall comply with, and shall cause its Subcontractors to comply with MGL. c. 149 § 148 which requires the weekly or biweekly payment of employees within six days of the end of the pay period during which wages were earned if employed for five or six days of a calendar week, and within other periods of time under certain circumstances as set forth therein.

11.5 VEHICLE AND EQUIPMENT OPERATORS

If the Director of the Department of Labor and Workforce Development has established a Schedule of wage rates to be paid to the operators of trucks, vehicles or equipment for this Project, the Contractor shall be obligated to pay such operators at least the minimum wage rate contained on such Schedule. (See M.G.L. c.149 §26-27H).

11.6 EIGHT HOUR DAY AND LODGING

11.6.1 The Contractor shall comply with MGL c. 149 § 30, 34 and 34A which provide that no laborer, workman, mechanic, foreman or inspector working in the employment of the Contractor, Subcontractor or other person doing or contracting to do the whole or part of the Work, shall be required or permitted to work any more than eight hours in any one day, or more than 48 hours in any one week, or more than six days in any one week, except in cases of emergency.

11.6.2 The Contractor shall comply with, and shall cause its Subcontractors to comply with, MGL c. 149 § 25 which provides that every employee on the Work shall lodge, board, and trade where and with whom he/she elects, and the Contractor and any Subcontractor shall not directly or indirectly require, as a condition of employment, that an employee lodge, board, or trade at a particular place or with a particular person.

11.7 EXECUTIVE ORDERS

The Contractor shall comply with the provisions of M.G.L. c.151B; Executive Order No. 227, Governor's Code of Fair Practices, Executive Order No. 237 pertaining to minority and women business development; Executive Order No. 246 pertaining to the handicapped and all regulations promulgated pursuant thereto. The aforementioned law, Executive Orders, and regulations are incorporated herein by reference and made a part of this Contract.

11.8 CONFLICT OF INTEREST.
The Contractor covenants, that (1) presently, there is no financial interest and shall not acquire any such interest, direct or indirect, which would conflict in any manner or degree with the performance of services required to be performed under this Agreement or which would violate M.G.L. c.268A, as amended; (2) in the performance of this Contract, no person having any such interest shall be employed by the Contractor or engaged as a subcontractor by the contractor; and (3) no partner or employee of the firm is related by blood or marriage to any Board Member or employee of the Awarding Authority.

ARTICLE 12
CONTRACTOR'S ACCOUNTING REQUIREMENTS

12.1 DEFINITIONS
The words defined herein shall have the meaning stated below whenever they appear in this Article 12.

12.1.1 "Contractor" means any person, corporation, partnership, joint venture, sole proprietorship, or other entity awarded this Contract.

12.1.2 "Contract" means any contract awarded or executed pursuant to M.G.L. c.30 §39M or M.G.L. c.149 §44A-J, which is for an amount greater than one hundred thousand dollars ($100,000).

12.1.3 "Records" means books of original entry, accounts, checks, bank statements and all other banking documents, correspondence, memoranda, invoices, computer printouts, tapes, discs, papers and other documents or transcribed information of any type, whether expressed in ordinary or machine language.

12.1.4 "Independent Certified Public Accountant" means a person duly registered in good standing and entitled to practice as a certified public accountant under the laws of the place of his/her residence or principal office and who is in fact independent.

12.1.5 "Audit," when used in regard to financial statements, means an examination of records by an independent certified public accountant in accordance with generally accepted accounting principles and auditing standards for the purpose of expressing a certified opinion thereon, or, in the alternative, a qualified opinion or a declination to express an opinion for stated reasons.

12.1.6 "Accountant's Report," when used in regard to financial statements, means a document in which an independent certified public accountant indicates the scope of the audit which he/she has made and sets forth his/her opinion regarding the financial statements taken as a whole with a listing of noted exceptions and qualifications, or an assertion to the effect that an overall opinion cannot be expressed. When an overall opinion cannot be expressed the reason therefore shall be stated. An accountant's report shall include a signed statement by the responsible corporate officer attesting that management has fully disclosed all material facts to the independent certified public accountant, and that the audited financial statement is a true and complete statement of the financial condition of the Contractor.

12.1.7 "Management," when used herein, means the chief executive officers, partners, principals or other person or persons primarily responsible for the financial and operational policies and practices of the Contractor.

12.1.8 Accounting terms, unless otherwise defined herein shall mean, in accordance with generally accepted accounting principles and auditing standards.

12.2 RECORD KEEPING

12.2.1 The Contractor shall make, and keep for at least six years after final payment, books, records, and accounts that in reasonable detail accurately and fairly reflect the transactions and dispositions of the Contractor.

12.2.2 Until the expiration of six years after final payment, the Inspector General and the Awarding Authority shall have the right to examine any books, documents, papers or records of the Contractor and Subcontractors that directly pertain to, and involve transactions relating to the Contractor and Subcontractors.

12.2.3 The Contractor shall describe any change in the method of maintaining records or recording transactions which materially affects any statements filed with the Awarding Authority including the date of the change and reasons therefore, and shall accompany said description with a letter from the Contractor's independent certified public accountant approving or otherwise commenting on the changes.

12.2.4 Prior to the execution of the Contract, the Contractor shall file a statement of management on internal accounting controls as set forth in Paragraph 12.3 below.

12.2.5 Prior to the execution of the Contract, the Contractor shall file an audited financial statement for the most recent completed fiscal year as set forth in Paragraph 12.4 below and will continue to file such statement annually during the term of the Contract.

12.3 STATEMENT OF MANAGEMENT CONTROLS

12.3.1 Prior to execution of the Contract, the Contractor shall file with the Awarding Authority a statement of management as to whether the system of internal accounting controls of the Contractor and its subsidiaries reasonably assures that:

- **.1** transactions are executed in accordance with management's general and specific authorization;
- **.2** transactions are recorded as necessary to:
  - **a.** to permit preparation of financial statements in conformity with generally accepted accounting principles, and
  - **b.** to maintain accountability for assets;
- **.3** access to assets is permitted only in accordance with management's general or specific authorization; and
- **.4** the recorded accountability for assets is compared with the existing assets at reasonable intervals and appropriate action was taken with respect to any difference.

12.3.2 Prior to execution of the Contract, the Contractor shall also file with the Awarding Authority a statement prepared and signed by an independent certified public accountant, stating that the accountant has examined the statement of management on internal accounting controls, and expressing an opinion as to:

- **.1** whether the representations of management in response to subparagraph 12.3.1 above are consistent with the results of management's evaluation of the system of internal accounting controls; and
- **.2** whether such representations of management are reasonable with respect to transactions and assets in amounts which would be material when measured in relation to the applicant's financial statement.

12.4 ANNUAL FINANCIAL STATEMENT

Every Contractor awarded a contract shall annually file with the Awarding Authority during the term of the Contract a financial statement prepared by an independent certified public accountant on the basis of an audit by such accountant. The final statement filed shall include the date of final payment. All statements shall be accompanied by an accountant's report.

ARTICLE 13
EQUAL EMPLOYMENT OPPORTUNITY REQUIREMENTS

13.1 DEFINITIONS
For purposes of this Article 13, the following additional definitions shall apply:

13.1.1 "Minority" means a person who meets one or more of the following definitions:

- **.1** American Indian or Native American means: all persons having origins in any of the original peoples of North America and who are recognized as an Indian by a tribe or tribal organization.
- **.2** Asian means: All persons having origins in any of the original peoples of the Far East, Southeast Asia, the Indian sub-continent, or the Pacific Islands, including, but Not limited to China, Japan, Korea, Samoa, India, and the Philippine Islands.
- **.3** Black means: All persons having origins in any of the Black racial groups of Africa, including, but not limited to, African-Americans, and all persons having origins in any of the original peoples of the Cape Verdean Islands.
- **.4** Eskimo or Aleut means: All persons having origins in any of the peoples of Northern Canada, Greenland, Alaska, and Eastern Siberia.
- **.5** Hispanic means: All persons having their origins in any of the Spanish-speaking peoples of Mexico, Puerto Rico, Cuba, Central or South America, or the Caribbean Islands.

13.2 CONDITIONS

13.2.1 The provisions of this Article 13 shall apply to the Contractor and all Subcontractors.

13.2.2 The Contractor shall not discriminate against any employee or applicant for employment because of race, color, religious creed, national origin, age, handicap, or sex. The aforesaid provision shall include, but not be limited to, the following: employment upgrading, demotion or transfer; recruitment advertising; recruitment layoff; termination; rates of pay or other forms of compensation; conditions or privileges of employment; and selection for apprenticeship. The Contractor must provide information as is necessary, in the judgment of the Awarding Authority, to ascertain compliance with the terms of Specification Section 00.73.36 and 00.73.37.

13.2.3 The Contractor shall post notices provided by the Commission, in conspicuous places, setting forth the provisions of the Fair Employment Practices Law of the Commonwealth.

13.2.4 The Contractor shall undertake in good faith affirmative action measures designed to eliminate any discriminatory barriers in the terms and conditions of employment on the grounds of race, color, religious creed, national origin, age, handicap, or sex, and to eliminate and remedy any effects of such discrimination in the past. Such affirmative action shall entail positive and aggressive measures to ensure equal opportunity in the areas of hiring, upgrading, demotion or transfer, recruitment, layoff or termination, rate of compensation, and in-service or apprenticeship training programs. This affirmative action shall include all action required to guarantee equal employment opportunity for all persons, regardless of race, color, religious creed, national origin, age or sex.

13.2.5 The Contractor shall not discriminate on grounds of race, color, religious creed, national origin, age, or sex in employment practices, in the selection or retention of Subcontractors, or in the procurement of materials and rentals of equipment.

13.2.6 The Commission and a designee of the Awarding Authority shall have access to the construction site and all applicable records of the Contractor and Subcontractors.

13.2.7 The Contractor's EEO Certificate must be signed by the low general and all filed sub-bidders as a condition of Contract validation by the Awarding Authority.

13.3 COMPLIANCE - REPORTS AND INFORMATION

The Contractor shall provide all information and reports required by the Awarding Authority and will permit access to its facilities and to any books, records, accounts and other sources of information that may be determined by the Awarding Authority to affect the employment of personnel. Where information required is in the exclusive possession of another who fails or refuses to furnish this information, the Contractor shall so certify to the Awarding Authority as appropriate and shall set forth what efforts have been made to obtain the information.

13.4 COMPLIANCE - INVESTIGATIONS

13.4.1 Whenever the Awarding Authority's EEO Officer or the MCAD believes the Contractor may not be operating in compliance with the terms of these requirements, the Awarding Authority shall conduct an investigation, and may confer with the parties, to verify such allegations. The Awarding Authority shall not initiate an investigation without prior notice to the Contractor.

13.4.2 If the Awarding Authority finds the Contractor in non-compliance, it shall make a preliminary report, and notify the Contractor in writing of the steps necessary to bring such Contractor into compliance. A copy of this report shall be sent to the Awarding Authority's Affirmative Action Officer.

13.5 COMPLIANCE - AWARDING AUTHORITY - AFFIRMATIVE ACTION INVESTIGATION

13.5.1 If the Contractor fails or refuses to fully perform the steps necessary to achieve compliance, the Awarding Authority shall make a report of non-compliance to the Awarding Authority's Affirmative Action Officer, who will then conduct an investigation.

13.5.2 Should the Awarding Authority's Affirmative Action Officer find the Contractor in non-compliance a final report recommending the imposition of one or more of the sanctions listed below shall be issued.

13.5.3 Within fifteen (15) days of said report the Awarding Authority shall, after due notice and giving the Contractor an opportunity to respond, move to impose one or more of the following sanctions to attain compliance.

13.5.4 If the Awarding Authority's Affirmative Action Office believes the Contractor has taken or is taking every possible measure to achieve compliance, a report shall show the Contractor is in compliance.

13.6 SANCTIONS

13.6.1 For each week that the Contractor fails or refuses to comply, the Awarding Authority may recover from the Contractor, 1/100 of 1% of the original Contract Sum or $1000 whichever sum is greater, in the nature of liquidated damages.

13.6.2 If a Subcontractor is in non-compliance, the Awarding Authority may recover from the Contractor, 1/10 of 1% of the Subcontract Sum, or $400 whichever sum is greater, in the nature of liquidated damages, to be assessed by the Contractor as a back charge against the Subcontractor for each week that Subcontractor fails or refuses to comply.

13.6.3 The Awarding Authority may suspend part or all of any payment due under the contract until such time as the Contractor or any Subcontractor is able to demonstrate compliance with the terms of the Contract;

13.6.4 The Awarding Authority may terminate, or cancel part or all of the Contract, in accordance with the provisions of Article 17, unless the Contractor or any Subcontractor is able to demonstrate, within a specified time, compliance with the terms of the Contract.

13.6.5 The Contractor may request the Awarding Authority to suspend the sanctions conditionally. Whereupon the Awarding Authority shall investigate corrective measures taken by the Contractor and shall either lift or re-impose the sanctions.

13.7 SEVERABILITY

The provisions of this article are severable, and if any of these provisions shall be held unconstitutional by any court of competent jurisdiction, the decision of such court shall not affect or impair any of the remaining provisions of the Contract.

ARTICLE 14
INSURANCE

14.1 INSURANCE REQUIREMENTS

14.1.1 The Contractor shall take out and maintain insurance coverage as listed in subparagraphs 14.2 - 14.8 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.

14.1.2 All policies shall be issued by companies authorized to write that type of insurance under the laws of this Commonwealth of Massachusetts.

14.2 CONTRACTOR'S COMMERCIAL GENERAL LIABILITY

14.2.1 Provide the following minimum coverage with respect to the operations performed by any employee, Subcontractor, or supplier:

Bodily Injury &	$1,000,000. each occurrence
Property Damage	$1,000,000. per project
Products & Completed Operations	$1,000,000. aggregate
Personal & Advertising Injury	$1,000,000. each occurrence

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

14.2.3 This policy shall include contractual liability coverage.

14.2.4 The Contractor shall provide a separate Awarding Authority's and Contractor's Protective Liability policy in the name of the Awarding Authority at the same limits listed above.

14.2.5 The completed operations coverage shall be maintained for a period of two (2) years after Substantial Completion as defined in subparagraph 8.6.1. The Contractor shall provide renewal certificates of insurance to the Awarding Authority as evidence that this coverage is being maintained. This policy shall include the Awarding Authority and anyone else requested by the Awarding Authority as an additional insured for ongoing and completed operations. This policy shall be primary and non-contributory with respect to any other insurance available to additional insured. This policy shall include a Waiver of Subrogation in favor of the Awarding Authority.

14.3 VEHICLE LIABILITY

Provide the following minimum coverage with respect to the operations of any employee, including coverage for owned, non-owned, and hired vehicles:

Bodily Injury and	$ 1,000,000. each person
Property Damage	$ 1,000,000. each accident
	Combined Single Limit of $1,000,000

14.4 WORKER'S COMPENSATION

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

Worker's Compensation	
Coverage A	Provide Statutory Minimum
Employer's Liability	$ 500,000. each accident
Coverage B	$ 500,000. disease per employee
	$ 500,000. disease policy

14.5 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 Awarding Authority and Prime Designer shall be named as an additional insured and coverage must be on an occurrence basis. The amount of coverage shall be as follows unless a higher amount is specified in Exhibit A to the Owner - Contractor Agreement, in which case the Contractor shall provide the additional coverage:

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

14.6 PROPERTY COVERAGE

14.6.1 Provide Special Perils coverage against loss or damage by fire and against loss or damage covered by the special perils insurance endorsement on all work included in this contract in an amount equal to at least 80% of Contract Amount.

14.6.2 When work will be completed on existing buildings owned by the Awarding Authority, the Contractor shall provide an installation floater, in the full amount of the Contract, for the requirements set forth in Subparagraph 14.5.

14.6.3 This policy and/or installation floater shall indicate if Stored Materials coverage is provided as required by Paragraph 9.4.

14.6.4 The policy or policies shall specifically state that they are for the benefit of and payable to the Awarding Authority, the Contractor, and all persons furnishing labor or labor and materials for the Contract Work, as their interests may appear.

14.6.5 The Builder's Risk (Special Perils) coverage shall include **a**ny costs for work performed by the Prime Designer or any consultant as the result of a loss experienced during the life of this contract.

14.7 AWARDING AUTHORITY AS ADDITIONAL INSURED

The Contractor's Commercial Liability, Vehicle Liability and Pollution Liability policies shall include the Awarding Authority and anyone else requested by the Awarding Authority as an additional insured for ongoing and completed operations. The policies shall be primary and non-contributory with respect to any other insurance available to additional insured. The policies shall include a Waiver of Subrogation in favor of the Awarding Authority.

14.8 CERTIFICATES OF INSURANCE, POLICIES

14.8.1 Certificates of insurance, acceptable to the Awarding Authority, shall be submitted to the Awarding Authority simultaneously with the execution of the Contract. Certificates shall indicate that the contractual liability coverage, and Awarding Authority's and Contractor's Protective Liability coverage is in force, as well as the deletions of the XCU exclusions.

14.8.2 The Contractor shall file the original and one certified copy of all policies with the Awarding Authority and one with the Awarding Authority within sixty days after Contract award. If the Awarding Authority is damaged by the Contractor's failure to maintain such insurance and to so notify the Awarding Authority, then the Contractor shall be responsible for all reasonable costs attributable thereto.

14.9 CANCELLATION

Cancellation of any insurance required by this Contract, whether by the insurer or the insured, shall not be valid unless written notice thereof is given by the party proposing cancellation to the other party and Awarding Authority at least thirty days prior to the effective date thereof, which shall be expressed in said notice.

ARTICLE 15
INDEMNIFICATION

15.1 The Contractor shall take all responsibility for the Work and take all precautions for preventing injuries to persons and property in or about the Work; shall bear all losses resulting from or on account of the amount or character of the Work. The Contractor shall pay or cause payment to be made for all labor performed or furnished and for all materials used or employed in carrying out this Contract. The Contractor shall assume the defense of, and indemnify and save harmless, the Prime Designer, the Awarding Authority and their officers and agents from all claims relating to: labor performed or furnished and materials used or employed for the Work; inventions, patents and patent rights used in and in doing the Work unless such patent infringement is due to a product or process specified by the Awarding Authority; injuries to any person or corporation received or sustained by or from the Contractor and any employees, and Subcontractors and employees, in doing the work, or in consequence of any improper materials, implements or labor used or employed therein; and any act, omission, or neglect of the Contractor and any employees.

15.2 The obligations of the Contractor under Section 1 above shall not extend to the liability of the Prime Designer, its agents or employees, arising out of (i) the preparation or approval of maps, drawings, opinions, reports, surveys, Change Orders, designs or specifications, or (ii) the giving of or the failure to give directions or instructions by the Prime Designer, its agents to employees provided such giving or failure to give is the primary cause of the injury or damage.

15.3 The provisions of this Article are intended to survive Final Acceptance and/or any termination of this Contract.

ARTICLE 16
PERFORMANCE AND PAYMENT BONDS

16.1 CONTRACTOR BONDS

16.1.1 The Contractor shall provide the Awarding Authority with performance and payment (labor and materials) bonds in the form provided by the Awarding Authority (Forms 00.61.01, 00.61.02 and 00.61.03), executed by a surety licensed by the Commonwealth's Division of Insurance. Each such bond shall be in the amount of the Contract Sum.

16.1.2 If at any time prior to final payment to the Contractor, the Surety:

- **.1** is adjudged bankrupt or has made a general assignment for the benefit of its creditors;
- **.2** has liquidated all assets and has made a general assignment for the benefit of its creditors;
- **.3** is placed in receivership;
- **.4** otherwise petitions a state or federal court for protection from its creditors; or
- **.5** allows its license to do business in Massachusetts to lapse or be revoked;

the Contractor shall, within 21 days of any such action listed above, provide the Awarding Authority with new performance and payment bonds as described in Paragraph 16.1.1. Such bonds shall be provided solely at the Contractor's expense.

16.2 SUBCONTRACTOR BONDS

16.2.1 The Contractor may list in its bid that any or all filed Subcontractors provide the Contractor with payment and performance bonds for the full amount of the Subcontract. The costs for said bonds shall be the responsibility of the Contractor.

16.2.2 In the event the Contractor lists in its bid that filed Subcontractors provide bonds, and subsequently waives the requirement, the Contractor shall provide the Awarding Authority with a certification that they understand if the filed subcontractor defaults or is terminated, the Contractor accepts full responsibility and costs related to said default or termination with a credit change order in an amount equal to the bond premium it would have paid had it required the filed Subcontractor to provide such bonds.

ARTICLE 17
TERMINATION

17.1 TERMINATION FOR CAUSE

17.1.1 The Awarding Authority may terminate this contract for cause if it determines that any of the following circumstances have occurred:

- **.1** The Contractor is adjudged bankrupt or has made a general assignment for the benefit of its creditors;
- **.2** A receiver has been appointed of the Contractor's property;
- **.3** All or a part of the Work has been abandoned;
- **.4** The Contractor has sublet or assigned all or any portion of the Work, the Contract, or claims thereunder, without the prior written consent of the Awarding Authority, except as provided in the Contract;
- **.5** The Prime Designer has determined that the rate of progress required on the project is not being met, or
- **.6** The Contractor has substantially violated any provisions of this Contract.

17.1.2 In the event of such termination, the Awarding Authority may hold the Contractor and its sureties liable in damages as for a breach of contract, or the Awarding Authority may notify the Contractor to discontinue all work, or any part thereof, and the Contractor shall discontinue all work, or any part thereof, as the Awarding Authority may designate.

17.1.3 The Awarding Authority may complete the work, or any part thereof, and charge the expense of completing the Work or part thereof, to the Contractor.

17.1.4 The Awarding Authority may take possession of and use any materials, machinery, implements and tools found upon the site of said Work. The Awarding Authority shall not be liable for any depreciation, loss or damage to said materials, machinery, implements or tools during said use and the Contractor shall be solely responsible for their removal from the Project site after the Awarding Authority has no further use for them.

17.1.5 The Awarding Authority may, at its option, require the surety or sureties to complete the Contract.

17.2 TERMINATION LIABILITIES

17.2.1 All expenses charged under Paragraph 17.1 shall be deducted and paid by the Awarding Authority out of any moneys then due or to become due the Contractor under this Contract; and in such accounting the Awarding Authority shall not be held to obtain the lowest figures, by competitive bid or otherwise, for the completion of the Work or any part thereof.

17.2.2 All sums actually paid by the Awarding Authority to complete the Work shall be charged to the Contractor. In case the expenses charged are less than the sum which would have been payable under this Contract if the same had been completed by the Contractor, the Contractor shall be entitled to receive the difference. In case such expenses shall exceed the said sum, the Contractor shall pay the amount of the excess to the Awarding Authority.

17.2.3 Expenses incurred under subparagraph 19.1 shall also include, but not be limited to, costs for Prime Designer's extra services and Project Representative services required, in the opinion of the Awarding Authority, to successfully inspect and administer the construction contract through final completion, as described in Paragraph 8.7.

17.3 TERMINATION - NO FAULT

17.3.1 In the event that this Contract is terminated by the Awarding Authority, and termination is not based on a reason listed in Paragraph 17.1, the Contractor shall be compensated for its costs incurred on the Project, including reasonable costs of de-mobilization, calculated on a percent completion basis as provided in Article 9, covering the period of time between the last periodic payment and the date of termination.

17.3.2 Payment by the Awarding Authority pursuant to Subparagraph 17.3.1 shall be considered to fully compensate the Contractor for all claims and expenses and those of any consultants, Subcontractors, and suppliers, directly or indirectly attributable to the termination, including any claims for lost profits.

17.4 ADMINISTRATOR'S APPROVAL

Termination of the Contract requires the prior approval of the Awarding Authority's authorized signatory.

END OF GENERAL CONDITIONS

AIA® Document A201™ – 2007

General Conditions of the Contract for Construction

for the following PROJECT:
(Name and location or address)

New DPW Facility
180 Turnpike Road, Turners Falls, MA

This document has important legal consequences. Consultation with an attorney is encouraged with respect to its completion or modification.

THE OWNER:
(Name, legal status and address)

Town of Montague
One Avenue A
Turners Falls, MA 01376

THE ARCHITECT:
(Name, legal status and address)

HELENE·KARL Architects, Inc.
61 Skyfields Drive
Groton, MA 01450

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ARTICLE 1 GENERAL PROVISIONS

§ 1.1 BASIC DEFINITIONS

§ 1.1.1 THE CONTRACT DOCUMENTS

The Contract Documents are enumerated in the Agreement between the Owner and Contractor (hereinafter the Agreement) and consist of the Agreement, Conditions of the Contract (General, Supplementary and other Conditions), Drawings, Specifications, Addenda issued prior to execution of the Contract, other documents listed in the Agreement and Modifications issued after execution of the Contract. A Modification is (1) a written amendment to the Contract signed by both parties, (2) a Change Order, (3) a Construction Change Directive or (4) a written order for a minor change in the Work issued by the Architect. Unless specifically enumerated in the Agreement, the Contract Documents do not include the advertisement or invitation to bid, Instructions to Bidders, sample forms, other information furnished by the Owner in anticipation of receiving bids or proposals, the Contractor's bid or proposal, or portions of Addenda relating to bidding requirements.

§ 1.1.2 THE CONTRACT

The Contract Documents form the Contract for Construction. The Contract represents the entire and integrated agreement between the parties hereto and supersedes prior negotiations, representations or agreements, either written or oral. The Contract may be amended or modified only by a Modification. The Contract Documents shall not be construed to create a contractual relationship of any kind (1) between the Contractor and the Architect or the Architect's consultants, (2) between the Owner and a Subcontractor or a Sub-subcontractor, (3) between the Owner and the Architect or the Architect's consultants or (4) between any persons or entities other than the Owner and the Contractor. The Architect shall, however, be entitled to performance and enforcement of obligations under the Contract intended to facilitate performance of the Architect's duties.

§ 1.1.3 THE WORK

The term "Work" means the construction and services required by the Contract Documents, whether completed or partially completed, and includes all other labor, materials, equipment and services provided or to be provided by the Contractor to fulfill the Contractor's obligations. The Work may constitute the whole or a part of the Project.

§ 1.1.4 THE PROJECT

The Project is the total construction of which the Work performed under the Contract Documents may be the whole or a part and which may include construction by the Owner and by separate contractors.

§ 1.1.5 THE DRAWINGS

The Drawings are the graphic and pictorial portions of the Contract Documents showing the design, location and dimensions of the Work, generally including plans, elevations, sections, details, schedules and diagrams.

§ 1.1.6 THE SPECIFICATIONS

The Specifications are that portion of the Contract Documents consisting of the written requirements for materials, equipment, systems, standards and workmanship for the Work, and performance of related services.

§ 1.1.7 INSTRUMENTS OF SERVICE

Instruments of Service are representations, in any medium of expression now known or later developed, of the tangible and intangible creative work performed by the Architect and the Architect's consultants under their respective professional services agreements. Instruments of Service may include, without limitation, studies, surveys, models, sketches, drawings, specifications, and other similar materials.

§ 1.1.8 INITIAL DECISION MAKER

The Initial Decision Maker is the person identified in the Agreement to render initial decisions on Claims in accordance with Section 15.2 and certify termination of the Agreement under Section 14.2.2.

§ 1.2 CORRELATION AND INTENT OF THE CONTRACT DOCUMENTS

§ 1.2.1 The intent of the Contract Documents is to include all items necessary for the proper execution and completion of the Work by the Contractor. The Contract Documents are complementary, and what is required by one shall be as binding as if required by all; performance by the Contractor shall be required only to the extent consistent with the Contract Documents and reasonably inferable from them as being necessary to produce the indicated results.

§ 1.2.2 Organization of the Specifications into divisions, sections and articles, and arrangement of Drawings shall not control the Contractor in dividing the Work among Subcontractors or in establishing the extent of Work to be performed by any trade.

§ 1.2.3 Unless otherwise stated in the Contract Documents, words that have well-known technical or construction industry meanings are used in the Contract Documents in accordance with such recognized meanings.

§ 1.3 CAPITALIZATION

Terms capitalized in these General Conditions include those that are (1) specifically defined, (2) the titles of numbered articles or (3) the titles of other documents published by the American Institute of Architects.

§ 1.4 INTERPRETATION

In the interest of brevity the Contract Documents frequently omit modifying words such as "all" and "any" and articles such as "the" and "an," but the fact that a modifier or an article is absent from one statement and appears in another is not intended to affect the interpretation of either statement.

§ 1.5 OWNERSHIP AND USE OF DRAWINGS, SPECIFICATIONS AND OTHER INSTRUMENTS OF SERVICE

§ 1.5.1 The Architect and the Architect's consultants shall be deemed the authors and owners of their respective Instruments of Service, including the Drawings and Specifications, and will retain all common law, statutory and other reserved rights, including copyrights. The Contractor, Subcontractors, Sub-subcontractors, and material or equipment suppliers shall not own or claim a copyright in the Instruments of Service. Submittal or distribution to meet official regulatory requirements or for other purposes in connection with this Project is not to be construed as publication in derogation of the Architect's or Architect's consultants' reserved rights.

§ 1.5.2 The Contractor, Subcontractors, Sub-subcontractors and material or equipment suppliers are authorized to use and reproduce the Instruments of Service provided to them solely and exclusively for execution of the Work. All copies made under this authorization shall bear the copyright notice, if any, shown on the Instruments of Service. The Contractor, Subcontractors, Sub-subcontractors, and material or equipment suppliers may not use the Instruments of Service on other projects or for additions to this Project outside the scope of the Work without the specific written consent of the Owner, Architect and the Architect's consultants.

§ 1.6 TRANSMISSION OF DATA IN DIGITAL FORM

If the parties intend to transmit Instruments of Service or any other information or documentation in digital form, they shall endeavor to establish necessary protocols governing such transmissions, unless otherwise already provided in the Agreement or the Contract Documents.

ARTICLE 2 OWNER

§ 2.1 GENERAL

§ 2.1.1 The Owner is the person or entity identified as such in the Agreement and is referred to throughout the Contract Documents as if singular in number. The Owner shall designate in writing a representative who shall have express authority to bind the Owner with respect to all matters requiring the Owner's approval or authorization. Except as otherwise provided in Section 4.2.1, the Architect does not have such authority. The term "Owner" means the Owner or the Owner's authorized representative.

§ 2.1.2 The Owner shall furnish to the Contractor within fifteen days after receipt of a written request, information necessary and relevant for the Contractor to evaluate, give notice of or enforce mechanic's lien rights. Such information shall include a correct statement of the record legal title to the property on which the Project is located, usually referred to as the site, and the Owner's interest therein.

§ 2.2 INFORMATION AND SERVICES REQUIRED OF THE OWNER

§ 2.2.1 Prior to commencement of the Work, the Contractor may request in writing that the Owner provide reasonable evidence that the Owner has made financial arrangements to fulfill the Owner's obligations under the Contract. Thereafter, the Contractor may only request such evidence if (1) the Owner fails to make payments to the Contractor as the Contract Documents require; (2) a change in the Work materially changes the Contract Sum; or (3) the Contractor identifies in writing a reasonable concern regarding the Owner's ability to make payment when due. The Owner shall furnish such evidence as a condition precedent to commencement or continuation of the Work or the portion of the Work affected by a material change. After the Owner furnishes the evidence, the Owner shall not materially vary such financial arrangements without prior notice to the Contractor.

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§ 2.2.2 Except for permits and fees that are the responsibility of the Contractor under the Contract Documents, including those required under Section 3.7.1, the Owner shall secure and pay for necessary approvals, easements, assessments and charges required for construction, use or occupancy of permanent structures or for permanent changes in existing facilities.

§ 2.2.3 The Owner shall furnish surveys describing physical characteristics, legal limitations and utility locations for the site of the Project, and a legal description of the site. The Contractor shall be entitled to rely on the accuracy of information furnished by the Owner but shall exercise proper precautions relating to the safe performance of the Work.

§ 2.2.4 The Owner shall furnish information or services required of the Owner by the Contract Documents with reasonable promptness. The Owner shall also furnish any other information or services under the Owner's control and relevant to the Contractor's performance of the Work with reasonable promptness after receiving the Contractor's written request for such information or services.

§ 2.2.5 Unless otherwise provided in the Contract Documents, the Owner shall furnish to the Contractor one copy of the Contract Documents for purposes of making reproductions pursuant to Section 1.5.2.

§ 2.3 OWNER'S RIGHT TO STOP THE WORK

If the Contractor fails to correct Work that is not in accordance with the requirements of the Contract Documents as required by Section 12.2 or repeatedly fails to carry out Work in accordance with the Contract Documents, the Owner may issue a written order to the Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, the right of the Owner to stop the Work shall not give rise to a duty on the part of the Owner to exercise this right for the benefit of the Contractor or any other person or entity, except to the extent required by Section 6.1.3.

§ 2.4 OWNER'S RIGHT TO CARRY OUT THE WORK

If the Contractor defaults or neglects to carry out the Work in accordance with the Contract Documents and fails within a ten-day period after receipt of written notice from the Owner to commence and continue correction of such default or neglect with diligence and promptness, the Owner may, without prejudice to other remedies the Owner may have, correct such deficiencies. In such case an appropriate Change Order shall be issued deducting from payments then or thereafter due the Contractor the reasonable cost of correcting such deficiencies, including Owner's expenses and compensation for the Architect's additional services made necessary by such default, neglect or failure. Such action by the Owner and amounts charged to the Contractor are both subject to prior approval of the Architect. If payments then or thereafter due the Contractor are not sufficient to cover such amounts, the Contractor shall pay the difference to the Owner.

ARTICLE 3 CONTRACTOR

§ 3.1 GENERAL

§ 3.1.1 The Contractor is the person or entity identified as such in the Agreement and is referred to throughout the Contract Documents as if singular in number. The Contractor shall be lawfully licensed, if required in the jurisdiction where the Project is located. The Contractor shall designate in writing a representative who shall have express authority to bind the Contractor with respect to all matters under this Contract. The term "Contractor" means the Contractor or the Contractor's authorized representative.

§ 3.1.2 The Contractor shall perform the Work in accordance with the Contract Documents.

§ 3.1.3 The Contractor shall not be relieved of obligations to perform the Work in accordance with the Contract Documents either by activities or duties of the Architect in the Architect's administration of the Contract, or by tests, inspections or approvals required or performed by persons or entities other than the Contractor.

§ 3.2 REVIEW OF CONTRACT DOCUMENTS AND FIELD CONDITIONS BY CONTRACTOR

§ 3.2.1 Execution of the Contract by the Contractor is a representation that the Contractor has visited the site, become generally familiar with local conditions under which the Work is to be performed and correlated personal observations with requirements of the Contract Documents.

§ 3.2.2 Because the Contract Documents are complementary, the Contractor shall, before starting each portion of the Work, carefully study and compare the various Contract Documents relative to that portion of the Work, as well as the information furnished by the Owner pursuant to Section 2.2.3, shall take field measurements of any existing conditions related to that portion of the Work, and shall observe any conditions at the site affecting it. These obligations are for the purpose of facilitating coordination and construction by the Contractor and are not for the purpose of discovering errors, omissions, or inconsistencies in the Contract Documents; however, the Contractor shall promptly report to the Architect any errors, inconsistencies or omissions discovered by or made known to the Contractor as a request for information in such form as the Architect may require. It is recognized that the Contractor's review is made in the Contractor's capacity as a contractor and not as a licensed design professional, unless otherwise specifically provided in the Contract Documents.

§ 3.2.3 The Contractor is not required to ascertain that the Contract Documents are in accordance with applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of public authorities, but the Contractor shall promptly report to the Architect any nonconformity discovered by or made known to the Contractor as a request for information in such form as the Architect may require.

§ 3.2.4 If the Contractor believes that additional cost or time is involved because of clarifications or instructions the Architect issues in response to the Contractor's notices or requests for information pursuant to Sections 3.2.2 or 3.2.3, the Contractor shall make Claims as provided in Article 15. If the Contractor fails to perform the obligations of Sections 3.2.2 or 3.2.3, the Contractor shall pay such costs and damages to the Owner as would have been avoided if the Contractor had performed such obligations. If the Contractor performs those obligations, the Contractor shall not be liable to the Owner or Architect for damages resulting from errors, inconsistencies or omissions in the Contract Documents, for differences between field measurements or conditions and the Contract Documents, or for nonconformities of the Contract Documents to applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities.

§ 3.3 SUPERVISION AND CONSTRUCTION PROCEDURES

§ 3.3.1 The Contractor shall supervise and direct the Work, using the Contractor's best skill and attention. The Contractor shall be solely responsible for, and have control over, construction means, methods, techniques, sequences and procedures and for coordinating all portions of the Work under the Contract, unless the Contract Documents give other specific instructions concerning these matters. If the Contract Documents give specific instructions concerning construction means, methods, techniques, sequences or procedures, the Contractor shall evaluate the jobsite safety thereof and, except as stated below, shall be fully and solely responsible for the jobsite safety of such means, methods, techniques, sequences or procedures. If the Contractor determines that such means, methods, techniques, sequences or procedures may not be safe, the Contractor shall give timely written notice to the Owner and Architect and shall not proceed with that portion of the Work without further written instructions from the Architect. If the Contractor is then instructed to proceed with the required means, methods, techniques, sequences or procedures without acceptance of changes proposed by the Contractor, the Owner shall be solely responsible for any loss or damage arising solely from those Owner-required means, methods, techniques, sequences or procedures.

§ 3.3.2 The Contractor shall be responsible to the Owner for acts and omissions of the Contractor's employees, Subcontractors and their agents and employees, and other persons or entities performing portions of the Work for, or on behalf of, the Contractor or any of its Subcontractors.

§ 3.3.3 The Contractor shall be responsible for inspection of portions of Work already performed to determine that such portions are in proper condition to receive subsequent Work.

§ 3.4 LABOR AND MATERIALS

§ 3.4.1 Unless otherwise provided in the Contract Documents, the Contractor shall provide and pay for labor, materials, equipment, tools, construction equipment and machinery, water, heat, utilities, transportation, and other facilities and services necessary for proper execution and completion of the Work, whether temporary or permanent and whether or not incorporated or to be incorporated in the Work.

§ 3.4.2 Except in the case of minor changes in the Work authorized by the Architect in accordance with Sections 3.12.8 or 7.4, the Contractor may make substitutions only with the consent of the Owner, after evaluation by the Architect and in accordance with a Change Order or Construction Change Directive.

§ 3.4.3 The Contractor shall enforce strict discipline and good order among the Contractor's employees and other persons carrying out the Work. The Contractor shall not permit employment of unfit persons or persons not properly skilled in tasks assigned to them.

§ 3.5 WARRANTY

The Contractor warrants to the Owner and Architect that materials and equipment furnished under the Contract will be of good quality and new unless the Contract Documents require or permit otherwise. The Contractor further warrants that the Work will conform to the requirements of the Contract Documents and will be free from defects, except for those inherent in the quality of the Work the Contract Documents require or permit. Work, materials, or equipment not conforming to these requirements may be considered defective. The Contractor's warranty excludes remedy for damage or defect caused by abuse, alterations to the Work not executed by the Contractor, improper or insufficient maintenance, improper operation, or normal wear and tear and normal usage. If required by the Architect, the Contractor shall furnish satisfactory evidence as to the kind and quality of materials and equipment.

§ 3.6 TAXES

The Contractor shall pay sales, consumer, use and similar taxes for the Work provided by the Contractor that are legally enacted when bids are received or negotiations concluded, whether or not yet effective or merely scheduled to go into effect.

§ 3.7 PERMITS, FEES, NOTICES AND COMPLIANCE WITH LAWS

§ 3.7.1 Unless otherwise provided in the Contract Documents, the Contractor shall secure and pay for the building permit as well as for other permits, fees, licenses, and inspections by government agencies necessary for proper execution and completion of the Work that are customarily secured after execution of the Contract and legally required at the time bids are received or negotiations concluded.

§ 3.7.2 The Contractor shall comply with and give notices required by applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities applicable to performance of the Work.

§ 3.7.3 If the Contractor performs Work knowing it to be contrary to applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of public authorities, the Contractor shall assume appropriate responsibility for such Work and shall bear the costs attributable to correction.

§ 3.7.4 CONCEALED OR UNKNOWN CONDITIONS

If the Contractor encounters conditions at the site that are (1) subsurface or otherwise concealed physical conditions that differ materially from those indicated in the Contract Documents or (2) unknown physical conditions of an unusual nature that differ materially from those ordinarily found to exist and generally recognized as inherent in construction activities of the character provided for in the Contract Documents, the Contractor shall promptly provide notice to the Owner and the Architect before conditions are disturbed and in no event later than 21 days after first observance of the conditions. The Architect will promptly investigate such conditions and, if the Architect determines that they differ materially and cause an increase or decrease in the Contractor's cost of, or time required for, performance of any part of the Work, will recommend an equitable adjustment in the Contract Sum or Contract Time, or both. If the Architect determines that the conditions at the site are not materially different from those indicated in the Contract Documents and that no change in the terms of the Contract is justified, the Architect shall promptly notify the Owner and Contractor in writing, stating the reasons. If either party disputes the Architect's determination or recommendation, that party may proceed as provided in Article 15.

§ 3.7.5 If, in the course of the Work, the Contractor encounters human remains or recognizes the existence of burial markers, archaeological sites or wetlands not indicated in the Contract Documents, the Contractor shall immediately suspend any operations that would affect them and shall notify the Owner and Architect. Upon receipt of such notice, the Owner shall promptly take any action necessary to obtain governmental authorization required to resume the operations. The Contractor shall continue to suspend such operations until otherwise instructed by the Owner but shall continue with all other operations that do not affect those remains or features. Requests for adjustments in the Contract Sum and Contract Time arising from the existence of such remains or features may be made as provided in Article 15.

§ 3.8 ALLOWANCES

§ 3.8.1 The Contractor shall include in the Contract Sum all allowances stated in the Contract Documents. Items covered by allowances shall be supplied for such amounts and by such persons or entities as the Owner may direct, but the Contractor shall not be required to employ persons or entities to whom the Contractor has reasonable objection.

§ 3.8.2 Unless otherwise provided in the Contract Documents:

.1 Allowances shall cover the cost to the Contractor of materials and equipment delivered at the site and all required taxes, less applicable trade discounts;

.2 Contractor's costs for unloading and handling at the site, labor, installation costs, overhead, profit and other expenses contemplated for stated allowance amounts shall be included in the Contract Sum but not in the allowances; and

.3 Whenever costs are more than or less than allowances, the Contract Sum shall be adjusted accordingly by Change Order. The amount of the Change Order shall reflect (1) the difference between actual costs and the allowances under Section 3.8.2.1 and (2) changes in Contractor's costs under Section 3.8.2.2.

§ 3.8.3 Materials and equipment under an allowance shall be selected by the Owner with reasonable promptness.

§ 3.9 SUPERINTENDENT

§ 3.9.1 The Contractor shall employ a competent superintendent and necessary assistants who shall be in attendance at the Project site during performance of the Work. The superintendent shall represent the Contractor, and communications given to the superintendent shall be as binding as if given to the Contractor.

§ 3.9.2 The Contractor, as soon as practicable after award of the Contract, shall furnish in writing to the Owner through the Architect the name and qualifications of a proposed superintendent. The Architect may reply within 14 days to the Contractor in writing stating (1) whether the Owner or the Architect has reasonable objection to the proposed superintendent or (2) that the Architect requires additional time to review. Failure of the Architect to reply within the 14 day period shall constitute notice of no reasonable objection.

§ 3.9.3 The Contractor shall not employ a proposed superintendent to whom the Owner or Architect has made reasonable and timely objection. The Contractor shall not change the superintendent without the Owner's consent, which shall not unreasonably be withheld or delayed.

§ 3.10 CONTRACTOR'S CONSTRUCTION SCHEDULES

§ 3.10.1 The Contractor, promptly after being awarded the Contract, shall prepare and submit for the Owner's and Architect's information a Contractor's construction schedule for the Work. The schedule shall not exceed time limits current under the Contract Documents, shall be revised at appropriate intervals as required by the conditions of the Work and Project, shall be related to the entire Project to the extent required by the Contract Documents, and shall provide for expeditious and practicable execution of the Work.

§ 3.10.2 The Contractor shall prepare a submittal schedule, promptly after being awarded the Contract and thereafter as necessary to maintain a current submittal schedule, and shall submit the schedule(s) for the Architect's approval. The Architect's approval shall not unreasonably be delayed or withheld. The submittal schedule shall (1) be coordinated with the Contractor's construction schedule, and (2) allow the Architect reasonable time to review submittals. If the Contractor fails to submit a submittal schedule, the Contractor shall not be entitled to any increase in Contract Sum or extension of Contract Time based on the time required for review of submittals.

§ 3.10.3 The Contractor shall perform the Work in general accordance with the most recent schedules submitted to the Owner and Architect.

§ 3.11 DOCUMENTS AND SAMPLES AT THE SITE

The Contractor shall maintain at the site for the Owner one copy of the Drawings, Specifications, Addenda, Change Orders and other Modifications, in good order and marked currently to indicate field changes and selections made during construction, and one copy of approved Shop Drawings, Product Data, Samples and similar required submittals. These shall be available to the Architect and shall be delivered to the Architect for submittal to the Owner upon completion of the Work as a record of the Work as constructed.

§ 3.12 SHOP DRAWINGS, PRODUCT DATA AND SAMPLES

§ 3.12.1 Shop Drawings are drawings, diagrams, schedules and other data specially prepared for the Work by the Contractor or a Subcontractor, Sub-subcontractor, manufacturer, supplier or distributor to illustrate some portion of the Work.

§ 3.12.2 Product Data are illustrations, standard schedules, performance charts, instructions, brochures, diagrams and other information furnished by the Contractor to illustrate materials or equipment for some portion of the Work.

§ 3.12.3 Samples are physical examples that illustrate materials, equipment or workmanship and establish standards by which the Work will be judged.

§ 3.12.4 Shop Drawings, Product Data, Samples and similar submittals are not Contract Documents. Their purpose is to demonstrate the way by which the Contractor proposes to conform to the information given and the design concept expressed in the Contract Documents for those portions of the Work for which the Contract Documents require submittals. Review by the Architect is subject to the limitations of Section 4.2.7. Informational submittals upon which the Architect is not expected to take responsive action may be so identified in the Contract Documents. Submittals that are not required by the Contract Documents may be returned by the Architect without action.

§ 3.12.5 The Contractor shall review for compliance with the Contract Documents, approve and submit to the Architect Shop Drawings, Product Data, Samples and similar submittals required by the Contract Documents in accordance with the submittal schedule approved by the Architect or, in the absence of an approved submittal schedule, with reasonable promptness and in such sequence as to cause no delay in the Work or in the activities of the Owner or of separate contractors.

§ 3.12.6 By submitting Shop Drawings, Product Data, Samples and similar submittals, the Contractor represents to the Owner and Architect that the Contractor has (1) reviewed and approved them, (2) determined and verified materials, field measurements and field construction criteria related thereto, or will do so and (3) checked and coordinated the information contained within such submittals with the requirements of the Work and of the Contract Documents.

§ 3.12.7 The Contractor shall perform no portion of the Work for which the Contract Documents require submittal and review of Shop Drawings, Product Data, Samples or similar submittals until the respective submittal has been approved by the Architect.

§ 3.12.8 The Work shall be in accordance with approved submittals except that the Contractor shall not be relieved of responsibility for deviations from requirements of the Contract Documents by the Architect's approval of Shop Drawings, Product Data, Samples or similar submittals unless the Contractor has specifically informed the Architect in writing of such deviation at the time of submittal and (1) the Architect has given written approval to the specific deviation as a minor change in the Work, or (2) a Change Order or Construction Change Directive has been issued authorizing the deviation. The Contractor shall not be relieved of responsibility for errors or omissions in Shop Drawings, Product Data, Samples or similar submittals by the Architect's approval thereof.

§ 3.12.9 The Contractor shall direct specific attention, in writing or on resubmitted Shop Drawings, Product Data, Samples or similar submittals, to revisions other than those requested by the Architect on previous submittals. In the absence of such written notice, the Architect's approval of a resubmission shall not apply to such revisions.

§ 3.12.10 The Contractor shall not be required to provide professional services that constitute the practice of architecture or engineering unless such services are specifically required by the Contract Documents for a portion of the Work or unless the Contractor needs to provide such services in order to carry out the Contractor's responsibilities for construction means, methods, techniques, sequences and procedures. The Contractor shall not be required to provide professional services in violation of applicable law. If professional design services or certifications by a design professional related to systems, materials or equipment are specifically required of the Contractor by the Contract Documents, the Owner and the Architect will specify all performance and design criteria that such services must satisfy. The Contractor shall cause such services or certifications to be provided by a properly licensed design professional, whose signature and seal shall appear on all drawings, calculations, specifications, certifications, Shop Drawings and other submittals prepared by such professional. Shop Drawings and other submittals related to the Work designed or certified by such professional, if prepared by others, shall bear such professional's written approval when submitted to the Architect. The Owner and the Architect shall be entitled

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to rely upon the adequacy, accuracy and completeness of the services, certifications and approvals performed or provided by such design professionals, provided the Owner and Architect have specified to the Contractor all performance and design criteria that such services must satisfy. Pursuant to this Section 3.12.10, the Architect will review, approve or take other appropriate action on submittals only for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents. The Contractor shall not be responsible for the adequacy of the performance and design criteria specified in the Contract Documents.

§ 3.13 USE OF SITE

The Contractor shall confine operations at the site to areas permitted by applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities and the Contract Documents and shall not unreasonably encumber the site with materials or equipment.

§ 3.14 CUTTING AND PATCHING

§ 3.14.1 The Contractor shall be responsible for cutting, fitting or patching required to complete the Work or to make its parts fit together properly. All areas requiring cutting, fitting and patching shall be restored to the condition existing prior to the cutting, fitting and patching, unless otherwise required by the Contract Documents.

§ 3.14.2 The Contractor shall not damage or endanger a portion of the Work or fully or partially completed construction of the Owner or separate contractors by cutting, patching or otherwise altering such construction, or by excavation. The Contractor shall not cut or otherwise alter such construction by the Owner or a separate contractor except with written consent of the Owner and of such separate contractor; such consent shall not be unreasonably withheld. The Contractor shall not unreasonably withhold from the Owner or a separate contractor the Contractor's consent to cutting or otherwise altering the Work.

§ 3.15 CLEANING UP

§ 3.15.1 The Contractor shall keep the premises and surrounding area free from accumulation of waste materials or rubbish caused by operations under the Contract. At completion of the Work, the Contractor shall remove waste materials, rubbish, the Contractor's tools, construction equipment, machinery and surplus materials from and about the Project.

§ 3.15.2 If the Contractor fails to clean up as provided in the Contract Documents, the Owner may do so and Owner shall be entitled to reimbursement from the Contractor.

§ 3.16 ACCESS TO WORK

The Contractor shall provide the Owner and Architect access to the Work in preparation and progress wherever located.

§ 3.17 ROYALTIES, PATENTS AND COPYRIGHTS

The Contractor shall pay all royalties and license fees. The Contractor shall defend suits or claims for infringement of copyrights and patent rights and shall hold the Owner and Architect harmless from loss on account thereof, but shall not be responsible for such defense or loss when a particular design, process or product of a particular manufacturer or manufacturers is required by the Contract Documents, or where the copyright violations are contained in Drawings, Specifications or other documents prepared by the Owner or Architect. However, if the Contractor has reason to believe that the required design, process or product is an infringement of a copyright or a patent, the Contractor shall be responsible for such loss unless such information is promptly furnished to the Architect.

§ 3.18 INDEMNIFICATION

§ 3.18.1 To the fullest extent permitted by law the Contractor shall indemnify and hold harmless the Owner, Architect, Architect's consultants, and agents and employees of any of them from and against claims, damages, losses and expenses, including but not limited to attorneys' fees, arising out of or resulting from performance of the Work, provided that such claim, damage, loss or expense is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself), but only to the extent caused by the negligent acts or omissions of the Contractor, a Subcontractor, anyone directly or indirectly employed by them or anyone for whose acts they may be liable, regardless of whether or not such claim, damage, loss or expense is caused in part by a party indemnified hereunder. Such obligation shall not be construed to negate, abridge, or reduce

other rights or obligations of indemnity that would otherwise exist as to a party or person described in this Section 3.18.

§ 3.18.2 In claims against any person or entity indemnified under this Section 3.18 by an employee of the Contractor, a Subcontractor, anyone directly or indirectly employed by them or anyone for whose acts they may be liable, the indemnification obligation under Section 3.18.1 shall not be limited by a limitation on amount or type of damages, compensation or benefits payable by or for the Contractor or a Subcontractor under workers' compensation acts, disability benefit acts or other employee benefit acts.

ARTICLE 4 ARCHITECT

§ 4.1 GENERAL

§ 4.1.1 The Owner shall retain an architect lawfully licensed to practice architecture or an entity lawfully practicing architecture in the jurisdiction where the Project is located. That person or entity is identified as the Architect in the Agreement and is referred to throughout the Contract Documents as if singular in number.

§ 4.1.2 Duties, responsibilities and limitations of authority of the Architect as set forth in the Contract Documents shall not be restricted, modified or extended without written consent of the Owner, Contractor and Architect. Consent shall not be unreasonably withheld.

§ 4.1.3 If the employment of the Architect is terminated, the Owner shall employ a successor architect as to whom the Contractor has no reasonable objection and whose status under the Contract Documents shall be that of the Architect.

§ 4.2 ADMINISTRATION OF THE CONTRACT

§ 4.2.1 The Architect will provide administration of the Contract as described in the Contract Documents and will be an Owner's representative during construction until the date the Architect issues the final Certificate for Payment. The Architect will have authority to act on behalf of the Owner only to the extent provided in the Contract Documents.

§ 4.2.2 The Architect will visit the site at intervals appropriate to the stage of construction, or as otherwise agreed with the Owner, to become generally familiar with the progress and quality of the portion of the Work completed, and to determine in general if the Work observed is being performed in a manner indicating that the Work, when fully completed, will be in accordance with the Contract Documents. However, the Architect will not be required to make exhaustive or continuous on-site inspections to check the quality or quantity of the Work. The Architect will not have control over, charge of, or responsibility for, the construction means, methods, techniques, sequences or procedures, or for the safety precautions and programs in connection with the Work, since these are solely the Contractor's rights and responsibilities under the Contract Documents, except as provided in Section 3.3.1.

§ 4.2.3 On the basis of the site visits, the Architect will keep the Owner reasonably informed about the progress and quality of the portion of the Work completed, and report to the Owner (1) known deviations from the Contract Documents and from the most recent construction schedule submitted by the Contractor, and (2) defects and deficiencies observed in the Work. The Architect will not be responsible for the Contractor's failure to perform the Work in accordance with the requirements of the Contract Documents. The Architect will not have control over or charge of and will not be responsible for acts or omissions of the Contractor, Subcontractors, or their agents or employees, or any other persons or entities performing portions of the Work.

§ 4.2.4 COMMUNICATIONS FACILITATING CONTRACT ADMINISTRATION

Except as otherwise provided in the Contract Documents or when direct communications have been specially authorized, the Owner and Contractor shall endeavor to communicate with each other through the Architect about matters arising out of or relating to the Contract. Communications by and with the Architect's consultants shall be through the Architect. Communications by and with Subcontractors and material suppliers shall be through the Contractor. Communications by and with separate contractors shall be through the Owner.

§ 4.2.5 Based on the Architect's evaluations of the Contractor's Applications for Payment, the Architect will review and certify the amounts due the Contractor and will issue Certificates for Payment in such amounts.

§ 4.2.6 The Architect has authority to reject Work that does not conform to the Contract Documents. Whenever the Architect considers it necessary or advisable, the Architect will have authority to require inspection or testing of the

Work in accordance with Sections 13.5.2 and 13.5.3, whether or not such Work is fabricated, installed or completed. However, neither this authority of the Architect nor a decision made in good faith either to exercise or not to exercise such authority shall give rise to a duty or responsibility of the Architect to the Contractor, Subcontractors, material and equipment suppliers, their agents or employees, or other persons or entities performing portions of the Work.

§ 4.2.7 The Architect will review and approve, or take other appropriate action upon, the Contractor's submittals such as Shop Drawings, Product Data and Samples, but only for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents. The Architect's action will be taken in accordance with the submittal schedule approved by the Architect or, in the absence of an approved submittal schedule, with reasonable promptness while allowing sufficient time in the Architect's professional judgment to permit adequate review. Review of such submittals is not conducted for the purpose of determining the accuracy and completeness of other details such as dimensions and quantities, or for substantiating instructions for installation or performance of equipment or systems, all of which remain the responsibility of the Contractor as required by the Contract Documents. The Architect's review of the Contractor's submittals shall not relieve the Contractor of the obligations under Sections 3.3, 3.5 and 3.12. The Architect's review shall not constitute approval of safety precautions or, unless otherwise specifically stated by the Architect, of any construction means, methods, techniques, sequences or procedures. The Architect's approval of a specific item shall not indicate approval of an assembly of which the item is a component.

§ 4.2.8 The Architect will prepare Change Orders and Construction Change Directives, and may authorize minor changes in the Work as provided in Section 7.4. The Architect will investigate and make determinations and recommendations regarding concealed and unknown conditions as provided in Section 3.7.4.

§ 4.2.9 The Architect will conduct inspections to determine the date or dates of Substantial Completion and the date of final completion; issue Certificates of Substantial Completion pursuant to Section 9.8; receive and forward to the Owner, for the Owner's review and records, written warranties and related documents required by the Contract and assembled by the Contractor pursuant to Section 9.10; and issue a final Certificate for Payment pursuant to Section 9.10.

§ 4.2.10 If the Owner and Architect agree, the Architect will provide one or more project representatives to assist in carrying out the Architect's responsibilities at the site. The duties, responsibilities and limitations of authority of such project representatives shall be as set forth in an exhibit to be incorporated in the Contract Documents.

§ 4.2.11 The Architect will interpret and decide matters concerning performance under, and requirements of, the Contract Documents on written request of either the Owner or Contractor. The Architect's response to such requests will be made in writing within any time limits agreed upon or otherwise with reasonable promptness.

§ 4.2.12 Interpretations and decisions of the Architect will be consistent with the intent of, and reasonably inferable from, the Contract Documents and will be in writing or in the form of drawings. When making such interpretations and decisions, the Architect will endeavor to secure faithful performance by both Owner and Contractor, will not show partiality to either and will not be liable for results of interpretations or decisions rendered in good faith.

§ 4.2.13 The Architect's decisions on matters relating to aesthetic effect will be final if consistent with the intent expressed in the Contract Documents.

§ 4.2.14 The Architect will review and respond to requests for information about the Contract Documents. The Architect's response to such requests will be made in writing within any time limits agreed upon or otherwise with reasonable promptness. If appropriate, the Architect will prepare and issue supplemental Drawings and Specifications in response to the requests for information.

ARTICLE 5 SUBCONTRACTORS

§ 5.1 DEFINITIONS

§ 5.1.1 A Subcontractor is a person or entity who has a direct contract with the Contractor to perform a portion of the Work at the site. The term "Subcontractor" is referred to throughout the Contract Documents as if singular in number and means a Subcontractor or an authorized representative of the Subcontractor. The term "Subcontractor" does not include a separate contractor or subcontractors of a separate contractor.

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§ 5.1.2 A Sub-subcontractor is a person or entity who has a direct or indirect contract with a Subcontractor to perform a portion of the Work at the site. The term "Sub-subcontractor" is referred to throughout the Contract Documents as if singular in number and means a Sub-subcontractor or an authorized representative of the Sub-subcontractor.

§ 5.2 AWARD OF SUBCONTRACTS AND OTHER CONTRACTS FOR PORTIONS OF THE WORK

§ 5.2.1 Unless otherwise stated in the Contract Documents or the bidding requirements, the Contractor, as soon as practicable after award of the Contract, shall furnish in writing to the Owner through the Architect the names of persons or entities (including those who are to furnish materials or equipment fabricated to a special design) proposed for each principal portion of the Work. The Architect may reply within 14 days to the Contractor in writing stating (1) whether the Owner or the Architect has reasonable objection to any such proposed person or entity or (2) that the Architect requires additional time for review. Failure of the Owner or Architect to reply within the 14-day period shall constitute notice of no reasonable objection.

§ 5.2.2 The Contractor shall not contract with a proposed person or entity to whom the Owner or Architect has made reasonable and timely objection. The Contractor shall not be required to contract with anyone to whom the Contractor has made reasonable objection.

§ 5.2.3 If the Owner or Architect has reasonable objection to a person or entity proposed by the Contractor, the Contractor shall propose another to whom the Owner or Architect has no reasonable objection. If the proposed but rejected Subcontractor was reasonably capable of performing the Work, the Contract Sum and Contract Time shall be increased or decreased by the difference, if any, occasioned by such change, and an appropriate Change Order shall be issued before commencement of the substitute Subcontractor's Work. However, no increase in the Contract Sum or Contract Time shall be allowed for such change unless the Contractor has acted promptly and responsively in submitting names as required.

§ 5.2.4 The Contractor shall not substitute a Subcontractor, person or entity previously selected if the Owner or Architect makes reasonable objection to such substitution.

§ 5.3 SUBCONTRACTUAL RELATIONS

By appropriate agreement, written where legally required for validity, the Contractor shall require each Subcontractor, to the extent of the Work to be performed by the Subcontractor, to be bound to the Contractor by terms of the Contract Documents, and to assume toward the Contractor all the obligations and responsibilities, including the responsibility for safety of the Subcontractor's Work, which the Contractor, by these Documents, assumes toward the Owner and Architect. Each subcontract agreement shall preserve and protect the rights of the Owner and Architect under the Contract Documents with respect to the Work to be performed by the Subcontractor so that subcontracting thereof will not prejudice such rights, and shall allow to the Subcontractor, unless specifically provided otherwise in the subcontract agreement, the benefit of all rights, remedies and redress against the Contractor that the Contractor, by the Contract Documents, has against the Owner. Where appropriate, the Contractor shall require each Subcontractor to enter into similar agreements with Sub-subcontractors. The Contractor shall make available to each proposed Subcontractor, prior to the execution of the subcontract agreement, copies of the Contract Documents to which the Subcontractor will be bound, and, upon written request of the Subcontractor, identify to the Subcontractor terms and conditions of the proposed subcontract agreement that may be at variance with the Contract Documents. Subcontractors will similarly make copies of applicable portions of such documents available to their respective proposed Sub-subcontractors.

§ 5.4 CONTINGENT ASSIGNMENT OF SUBCONTRACTS

§ 5.4.1 Each subcontract agreement for a portion of the Work is assigned by the Contractor to the Owner, provided that

.1 assignment is effective only after termination of the Contract by the Owner for cause pursuant to Section 14.2 and only for those subcontract agreements that the Owner accepts by notifying the Subcontractor and Contractor in writing; and

.2 assignment is subject to the prior rights of the surety, if any, obligated under bond relating to the Contract.

When the Owner accepts the assignment of a subcontract agreement, the Owner assumes the Contractor's rights and obligations under the subcontract.

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§ 5.4.2 Upon such assignment, if the Work has been suspended for more than 30 days, the Subcontractor's compensation shall be equitably adjusted for increases in cost resulting from the suspension.

§ 5.4.3 Upon such assignment to the Owner under this Section 5.4, the Owner may further assign the subcontract to a successor contractor or other entity. If the Owner assigns the subcontract to a successor contractor or other entity, the Owner shall nevertheless remain legally responsible for all of the successor contractor's obligations under the subcontract.

ARTICLE 6 CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS

§ 6.1 OWNER'S RIGHT TO PERFORM CONSTRUCTION AND TO AWARD SEPARATE CONTRACTS

§ 6.1.1 The Owner reserves the right to perform construction or operations related to the Project with the Owner's own forces, and to award separate contracts in connection with other portions of the Project or other construction or operations on the site under Conditions of the Contract identical or substantially similar to these including those portions related to insurance and waiver of subrogation. If the Contractor claims that delay or additional cost is involved because of such action by the Owner, the Contractor shall make such Claim as provided in Article 15.

§ 6.1.2 When separate contracts are awarded for different portions of the Project or other construction or operations on the site, the term "Contractor" in the Contract Documents in each case shall mean the Contractor who executes each separate Owner-Contractor Agreement.

§ 6.1.3 The Owner shall provide for coordination of the activities of the Owner's own forces and of each separate contractor with the Work of the Contractor, who shall cooperate with them. The Contractor shall participate with other separate contractors and the Owner in reviewing their construction schedules. The Contractor shall make any revisions to the construction schedule deemed necessary after a joint review and mutual agreement. The construction schedules shall then constitute the schedules to be used by the Contractor, separate contractors and the Owner until subsequently revised.

§ 6.1.4 Unless otherwise provided in the Contract Documents, when the Owner performs construction or operations related to the Project with the Owner's own forces, the Owner shall be deemed to be subject to the same obligations and to have the same rights that apply to the Contractor under the Conditions of the Contract, including, without excluding others, those stated in Article 3, this Article 6 and Articles 10, 11 and 12.

§ 6.2 MUTUAL RESPONSIBILITY

§ 6.2.1 The Contractor shall afford the Owner and separate contractors reasonable opportunity for introduction and storage of their materials and equipment and performance of their activities, and shall connect and coordinate the Contractor's construction and operations with theirs as required by the Contract Documents.

§ 6.2.2 If part of the Contractor's Work depends for proper execution or results upon construction or operations by the Owner or a separate contractor, the Contractor shall, prior to proceeding with that portion of the Work, promptly report to the Architect apparent discrepancies or defects in such other construction that would render it unsuitable for such proper execution and results. Failure of the Contractor so to report shall constitute an acknowledgment that the Owner's or separate contractor's completed or partially completed construction is fit and proper to receive the Contractor's Work, except as to defects not then reasonably discoverable.

§ 6.2.3 The Contractor shall reimburse the Owner for costs the Owner incurs that are payable to a separate contractor because of the Contractor's delays, improperly timed activities or defective construction. The Owner shall be responsible to the Contractor for costs the Contractor incurs because of a separate contractor's delays, improperly timed activities, damage to the Work or defective construction.

§ 6.2.4 The Contractor shall promptly remedy damage the Contractor wrongfully causes to completed or partially completed construction or to property of the Owner or separate contractors as provided in Section 10.2.5.

§ 6.2.5 The Owner and each separate contractor shall have the same responsibilities for cutting and patching as are described for the Contractor in Section 3.14.

§ 6.3 OWNER'S RIGHT TO CLEAN UP

If a dispute arises among the Contractor, separate contractors and the Owner as to the responsibility under their respective contracts for maintaining the premises and surrounding area free from waste materials and rubbish, the Owner may clean up and the Architect will allocate the cost among those responsible.

ARTICLE 7 CHANGES IN THE WORK

§ 7.1 GENERAL

§ 7.1.1 Changes in the Work may be accomplished after execution of the Contract, and without invalidating the Contract, by Change Order, Construction Change Directive or order for a minor change in the Work, subject to the limitations stated in this Article 7 and elsewhere in the Contract Documents.

§ 7.1.2 A Change Order shall be based upon agreement among the Owner, Contractor and Architect; a Construction Change Directive requires agreement by the Owner and Architect and may or may not be agreed to by the Contractor; an order for a minor change in the Work may be issued by the Architect alone.

§ 7.1.3 Changes in the Work shall be performed under applicable provisions of the Contract Documents, and the Contractor shall proceed promptly, unless otherwise provided in the Change Order, Construction Change Directive or order for a minor change in the Work.

§ 7.2 CHANGE ORDERS

§ 7.2.1 A Change Order is a written instrument prepared by the Architect and signed by the Owner, Contractor and Architect stating their agreement upon all of the following:

.1 The change in the Work;
.2 The amount of the adjustment, if any, in the Contract Sum; and
.3 The extent of the adjustment, if any, in the Contract Time.

§ 7.3 CONSTRUCTION CHANGE DIRECTIVES

§ 7.3.1 A Construction Change Directive is a written order prepared by the Architect and signed by the Owner and Architect, directing a change in the Work prior to agreement on adjustment, if any, in the Contract Sum or Contract Time, or both. The Owner may by Construction Change Directive, without invalidating the Contract, order changes in the Work within the general scope of the Contract consisting of additions, deletions or other revisions, the Contract Sum and Contract Time being adjusted accordingly.

§ 7.3.2 A Construction Change Directive shall be used in the absence of total agreement on the terms of a Change Order.

§ 7.3.3 If the Construction Change Directive provides for an adjustment to the Contract Sum, the adjustment shall be based on one of the following methods:

.1 Mutual acceptance of a lump sum properly itemized and supported by sufficient substantiating data to permit evaluation;
.2 Unit prices stated in the Contract Documents or subsequently agreed upon;
.3 Cost to be determined in a manner agreed upon by the parties and a mutually acceptable fixed or percentage fee; or
.4 As provided in Section 7.3.7.

§ 7.3.4 If unit prices are stated in the Contract Documents or subsequently agreed upon, and if quantities originally contemplated are materially changed in a proposed Change Order or Construction Change Directive so that application of such unit prices to quantities of Work proposed will cause substantial inequity to the Owner or Contractor, the applicable unit prices shall be equitably adjusted.

§ 7.3.5 Upon receipt of a Construction Change Directive, the Contractor shall promptly proceed with the change in the Work involved and advise the Architect of the Contractor's agreement or disagreement with the method, if any, provided in the Construction Change Directive for determining the proposed adjustment in the Contract Sum or Contract Time.

§ 7.3.6 A Construction Change Directive signed by the Contractor indicates the Contractor's agreement therewith, including adjustment in Contract Sum and Contract Time or the method for determining them. Such agreement shall be effective immediately and shall be recorded as a Change Order.

§ 7.3.7 If the Contractor does not respond promptly or disagrees with the method for adjustment in the Contract Sum, the Architect shall determine the method and the adjustment on the basis of reasonable expenditures and savings of those performing the Work attributable to the change, including, in case of an increase in the Contract Sum, an amount for overhead and profit as set forth in the Agreement, or if no such amount is set forth in the Agreement, a reasonable amount. In such case, and also under Section 7.3.3.3, the Contractor shall keep and present, in such form as the Architect may prescribe, an itemized accounting together with appropriate supporting data. Unless otherwise provided in the Contract Documents, costs for the purposes of this Section 7.3.7 shall be limited to the following:

.1 Costs of labor, including social security, old age and unemployment insurance, fringe benefits required by agreement or custom, and workers' compensation insurance;

.2 Costs of materials, supplies and equipment, including cost of transportation, whether incorporated or consumed;

.3 Rental costs of machinery and equipment, exclusive of hand tools, whether rented from the Contractor or others;

.4 Costs of premiums for all bonds and insurance, permit fees, and sales, use or similar taxes related to the Work; and

.5 Additional costs of supervision and field office personnel directly attributable to the change.

§ 7.3.8 The amount of credit to be allowed by the Contractor to the Owner for a deletion or change that results in a net decrease in the Contract Sum shall be actual net cost as confirmed by the Architect. When both additions and credits covering related Work or substitutions are involved in a change, the allowance for overhead and profit shall be figured on the basis of net increase, if any, with respect to that change.

§ 7.3.9 Pending final determination of the total cost of a Construction Change Directive to the Owner, the Contractor may request payment for Work completed under the Construction Change Directive in Applications for Payment. The Architect will make an interim determination for purposes of monthly certification for payment for those costs and certify for payment the amount that the Architect determines, in the Architect's professional judgment, to be reasonably justified. The Architect's interim determination of cost shall adjust the Contract Sum on the same basis as a Change Order, subject to the right of either party to disagree and assert a Claim in accordance with Article 15.

§ 7.3.10 When the Owner and Contractor agree with a determination made by the Architect concerning the adjustments in the Contract Sum and Contract Time, or otherwise reach agreement upon the adjustments, such agreement shall be effective immediately and the Architect will prepare a Change Order. Change Orders may be issued for all or any part of a Construction Change Directive.

§ 7.4 MINOR CHANGES IN THE WORK

The Architect has authority to order minor changes in the Work not involving adjustment in the Contract Sum or extension of the Contract Time and not inconsistent with the intent of the Contract Documents. Such changes will be effected by written order signed by the Architect and shall be binding on the Owner and Contractor.

ARTICLE 8 TIME

§ 8.1 DEFINITIONS

§ 8.1.1 Unless otherwise provided, Contract Time is the period of time, including authorized adjustments, allotted in the Contract Documents for Substantial Completion of the Work.

§ 8.1.2 The date of commencement of the Work is the date established in the Agreement.

§ 8.1.3 The date of Substantial Completion is the date certified by the Architect in accordance with Section 9.8.

§ 8.1.4 The term "day" as used in the Contract Documents shall mean calendar day unless otherwise specifically defined.

§ 8.2 PROGRESS AND COMPLETION

§ 8.2.1 Time limits stated in the Contract Documents are of the essence of the Contract. By executing the Agreement the Contractor confirms that the Contract Time is a reasonable period for performing the Work.

§ 8.2.2 The Contractor shall not knowingly, except by agreement or instruction of the Owner in writing, prematurely commence operations on the site or elsewhere prior to the effective date of insurance required by Article 11 to be

furnished by the Contractor and Owner. The date of commencement of the Work shall not be changed by the effective date of such insurance.

§ 8.2.3 The Contractor shall proceed expeditiously with adequate forces and shall achieve Substantial Completion within the Contract Time.

§ 8.3 DELAYS AND EXTENSIONS OF TIME

§ 8.3.1 If the Contractor is delayed at any time in the commencement or progress of the Work by an act or neglect of the Owner or Architect, or of an employee of either, or of a separate contractor employed by the Owner; or by changes ordered in the Work; or by labor disputes, fire, unusual delay in deliveries, unavoidable casualties or other causes beyond the Contractor's control; or by delay authorized by the Owner pending mediation and arbitration; or by other causes that the Architect determines may justify delay, then the Contract Time shall be extended by Change Order for such reasonable time as the Architect may determine.

§ 8.3.2 Claims relating to time shall be made in accordance with applicable provisions of Article 15.

§ 8.3.3 This Section 8.3 does not preclude recovery of damages for delay by either party under other provisions of the Contract Documents.

ARTICLE 9 PAYMENTS AND COMPLETION

§ 9.1 CONTRACT SUM

The Contract Sum is stated in the Agreement and, including authorized adjustments, is the total amount payable by the Owner to the Contractor for performance of the Work under the Contract Documents.

§ 9.2 SCHEDULE OF VALUES

Where the Contract is based on a stipulated sum or Guaranteed Maximum Price, the Contractor shall submit to the Architect, before the first Application for Payment, a schedule of values allocating the entire Contract Sum to the various portions of the Work and prepared in such form and supported by such data to substantiate its accuracy as the Architect may require. This schedule, unless objected to by the Architect, shall be used as a basis for reviewing the Contractor's Applications for Payment.

§ 9.3 APPLICATIONS FOR PAYMENT

§ 9.3.1 At least ten days before the date established for each progress payment, the Contractor shall submit to the Architect an itemized Application for Payment prepared in accordance with the schedule of values, if required under Section 9.2, for completed portions of the Work. Such application shall be notarized, if required, and supported by such data substantiating the Contractor's right to payment as the Owner or Architect may require, such as copies of requisitions from Subcontractors and material suppliers, and shall reflect retainage if provided for in the Contract Documents.

§ 9.3.1.1 As provided in Section 7.3.9, such applications may include requests for payment on account of changes in the Work that have been properly authorized by Construction Change Directives, or by interim determinations of the Architect, but not yet included in Change Orders.

§ 9.3.1.2 Applications for Payment shall not include requests for payment for portions of the Work for which the Contractor does not intend to pay a Subcontractor or material supplier, unless such Work has been performed by others whom the Contractor intends to pay.

§ 9.3.2 Unless otherwise provided in the Contract Documents, payments shall be made on account of materials and equipment delivered and suitably stored at the site for subsequent incorporation in the Work. If approved in advance by the Owner, payment may similarly be made for materials and equipment suitably stored off the site at a location agreed upon in writing. Payment for materials and equipment stored on or off the site shall be conditioned upon compliance by the Contractor with procedures satisfactory to the Owner to establish the Owner's title to such materials and equipment or otherwise protect the Owner's interest, and shall include the costs of applicable insurance, storage and transportation to the site for such materials and equipment stored off the site.

§ 9.3.3 The Contractor warrants that title to all Work covered by an Application for Payment will pass to the Owner no later than the time of payment. The Contractor further warrants that upon submittal of an Application for Payment all Work for which Certificates for Payment have been previously issued and payments received from the

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Owner shall, to the best of the Contractor's knowledge, information and belief, be free and clear of liens, claims, security interests or encumbrances in favor of the Contractor, Subcontractors, material suppliers, or other persons or entities making a claim by reason of having provided labor, materials and equipment relating to the Work.

§ 9.4 CERTIFICATES FOR PAYMENT

§ 9.4.1 The Architect will, within seven days after receipt of the Contractor's Application for Payment, either issue to the Owner a Certificate for Payment, with a copy to the Contractor, for such amount as the Architect determines is properly due, or notify the Contractor and Owner in writing of the Architect's reasons for withholding certification in whole or in part as provided in Section 9.5.1.

§ 9.4.2 The issuance of a Certificate for Payment will constitute a representation by the Architect to the Owner, based on the Architect's evaluation of the Work and the data comprising the Application for Payment, that, to the best of the Architect's knowledge, information and belief, the Work has progressed to the point indicated and that the quality of the Work is in accordance with the Contract Documents. The foregoing representations are subject to an evaluation of the Work for conformance with the Contract Documents upon Substantial Completion, to results of subsequent tests and inspections, to correction of minor deviations from the Contract Documents prior to completion and to specific qualifications expressed by the Architect. The issuance of a Certificate for Payment will further constitute a representation that the Contractor is entitled to payment in the amount certified. However, the issuance of a Certificate for Payment will not be a representation that the Architect has (1) made exhaustive or continuous on-site inspections to check the quality or quantity of the Work, (2) reviewed construction means, methods, techniques, sequences or procedures, (3) reviewed copies of requisitions received from Subcontractors and material suppliers and other data requested by the Owner to substantiate the Contractor's right to payment, or (4) made examination to ascertain how or for what purpose the Contractor has used money previously paid on account of the Contract Sum.

§ 9.5 DECISIONS TO WITHHOLD CERTIFICATION

§ 9.5.1 The Architect may withhold a Certificate for Payment in whole or in part, to the extent reasonably necessary to protect the Owner, if in the Architect's opinion the representations to the Owner required by Section 9.4.2 cannot be made. If the Architect is unable to certify payment in the amount of the Application, the Architect will notify the Contractor and Owner as provided in Section 9.4.1. If the Contractor and Architect cannot agree on a revised amount, the Architect will promptly issue a Certificate for Payment for the amount for which the Architect is able to make such representations to the Owner. The Architect may also withhold a Certificate for Payment or, because of subsequently discovered evidence, may nullify the whole or a part of a Certificate for Payment previously issued, to such extent as may be necessary in the Architect's opinion to protect the Owner from loss for which the Contractor is responsible, including loss resulting from acts and omissions described in Section 3.3.2, because of

.1 defective Work not remedied;
.2 third party claims filed or reasonable evidence indicating probable filing of such claims unless security acceptable to the Owner is provided by the Contractor;
.3 failure of the Contractor to make payments properly to Subcontractors or for labor, materials or equipment;
.4 reasonable evidence that the Work cannot be completed for the unpaid balance of the Contract Sum;
.5 damage to the Owner or a separate contractor;
.6 reasonable evidence that the Work will not be completed within the Contract Time, and that the unpaid balance would not be adequate to cover actual or liquidated damages for the anticipated delay; or
.7 repeated failure to carry out the Work in accordance with the Contract Documents.

§ 9.5.2 When the above reasons for withholding certification are removed, certification will be made for amounts previously withheld.

§ 9.5.3 If the Architect withholds certification for payment under Section 9.5.1.3, the Owner may, at its sole option, issue joint checks to the Contractor and to any Subcontractor or material or equipment suppliers to whom the Contractor failed to make payment for Work properly performed or material or equipment suitably delivered. If the Owner makes payments by joint check, the Owner shall notify the Architect and the Architect will reflect such payment on the next Certificate for Payment.

§ 9.6 PROGRESS PAYMENTS

§ 9.6.1 After the Architect has issued a Certificate for Payment, the Owner shall make payment in the manner and within the time provided in the Contract Documents, and shall so notify the Architect.

§ 9.6.2 The Contractor shall pay each Subcontractor no later than seven days after receipt of payment from the Owner the amount to which the Subcontractor is entitled, reflecting percentages actually retained from payments to the Contractor on account of the Subcontractor's portion of the Work. The Contractor shall, by appropriate agreement with each Subcontractor, require each Subcontractor to make payments to Sub-subcontractors in a similar manner.

§ 9.6.3 The Architect will, on request, furnish to a Subcontractor, if practicable, information regarding percentages of completion or amounts applied for by the Contractor and action taken thereon by the Architect and Owner on account of portions of the Work done by such Subcontractor.

§ 9.6.4 The Owner has the right to request written evidence from the Contractor that the Contractor has properly paid Subcontractors and material and equipment suppliers amounts paid by the Owner to the Contractor for subcontracted Work. If the Contractor fails to furnish such evidence within seven days, the Owner shall have the right to contact Subcontractors to ascertain whether they have been properly paid. Neither the Owner nor Architect shall have an obligation to pay or to see to the payment of money to a Subcontractor, except as may otherwise be required by law.

§ 9.6.5 Contractor payments to material and equipment suppliers shall be treated in a manner similar to that provided in Sections 9.6.2, 9.6.3 and 9.6.4.

§ 9.6.6 A Certificate for Payment, a progress payment, or partial or entire use or occupancy of the Project by the Owner shall not constitute acceptance of Work not in accordance with the Contract Documents.

§ 9.6.7 Unless the Contractor provides the Owner with a payment bond in the full penal sum of the Contract Sum, payments received by the Contractor for Work properly performed by Subcontractors and suppliers shall be held by the Contractor for those Subcontractors or suppliers who performed Work or furnished materials, or both, under contract with the Contractor for which payment was made by the Owner. Nothing contained herein shall require money to be placed in a separate account and not commingled with money of the Contractor, shall create any fiduciary liability or tort liability on the part of the Contractor for breach of trust or shall entitle any person or entity to an award of punitive damages against the Contractor for breach of the requirements of this provision.

§ 9.7 FAILURE OF PAYMENT

If the Architect does not issue a Certificate for Payment, through no fault of the Contractor, within seven days after receipt of the Contractor's Application for Payment, or if the Owner does not pay the Contractor within seven days after the date established in the Contract Documents the amount certified by the Architect or awarded by binding dispute resolution, then the Contractor may, upon seven additional days' written notice to the Owner and Architect, stop the Work until payment of the amount owing has been received. The Contract Time shall be extended appropriately and the Contract Sum shall be increased by the amount of the Contractor's reasonable costs of shut-down, delay and start-up, plus interest as provided for in the Contract Documents.

§ 9.8 SUBSTANTIAL COMPLETION

§ 9.8.1 Substantial Completion is the stage in the progress of the Work when the Work or designated portion thereof is sufficiently complete in accordance with the Contract Documents so that the Owner can occupy or utilize the Work for its intended use.

§ 9.8.2 When the Contractor considers that the Work, or a portion thereof which the Owner agrees to accept separately, is substantially complete, the Contractor shall prepare and submit to the Architect a comprehensive list of items to be completed or corrected prior to final payment. Failure to include an item on such list does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract Documents.

§ 9.8.3 Upon receipt of the Contractor's list, the Architect will make an inspection to determine whether the Work or designated portion thereof is substantially complete. If the Architect's inspection discloses any item, whether or not included on the Contractor's list, which is not sufficiently complete in accordance with the Contract Documents so that the Owner can occupy or utilize the Work or designated portion thereof for its intended use, the Contractor shall, before issuance of the Certificate of Substantial Completion, complete or correct such item upon notification by the Architect. In such case, the Contractor shall then submit a request for another inspection by the Architect to determine Substantial Completion.

§ 9.8.4 When the Work or designated portion thereof is substantially complete, the Architect will prepare a Certificate of Substantial Completion that shall establish the date of Substantial Completion, shall establish responsibilities of the Owner and Contractor for security, maintenance, heat, utilities, damage to the Work and insurance, and shall fix the time within which the Contractor shall finish all items on the list accompanying the Certificate. Warranties required by the Contract Documents shall commence on the date of Substantial Completion of the Work or designated portion thereof unless otherwise provided in the Certificate of Substantial Completion.

§ 9.8.5 The Certificate of Substantial Completion shall be submitted to the Owner and Contractor for their written acceptance of responsibilities assigned to them in such Certificate. Upon such acceptance and consent of surety, if any, the Owner shall make payment of retainage applying to such Work or designated portion thereof. Such payment shall be adjusted for Work that is incomplete or not in accordance with the requirements of the Contract Documents.

§ 9.9 PARTIAL OCCUPANCY OR USE

§ 9.9.1 The Owner may occupy or use any completed or partially completed portion of the Work at any stage when such portion is designated by separate agreement with the Contractor, provided such occupancy or use is consented to by the insurer as required under Section 11.3.1.5 and authorized by public authorities having jurisdiction over the Project. Such partial occupancy or use may commence whether or not the portion is substantially complete, provided the Owner and Contractor have accepted in writing the responsibilities assigned to each of them for payments, retainage, if any, security, maintenance, heat, utilities, damage to the Work and insurance, and have agreed in writing concerning the period for correction of the Work and commencement of warranties required by the Contract Documents. When the Contractor considers a portion substantially complete, the Contractor shall prepare and submit a list to the Architect as provided under Section 9.8.2. Consent of the Contractor to partial occupancy or use shall not be unreasonably withheld. The stage of the progress of the Work shall be determined by written agreement between the Owner and Contractor or, if no agreement is reached, by decision of the Architect.

§ 9.9.2 Immediately prior to such partial occupancy or use, the Owner, Contractor and Architect shall jointly inspect the area to be occupied or portion of the Work to be used in order to determine and record the condition of the Work.

§ 9.9.3 Unless otherwise agreed upon, partial occupancy or use of a portion or portions of the Work shall not constitute acceptance of Work not complying with the requirements of the Contract Documents.

§ 9.10 FINAL COMPLETION AND FINAL PAYMENT

§ 9.10.1 Upon receipt of the Contractor's written notice that the Work is ready for final inspection and acceptance and upon receipt of a final Application for Payment, the Architect will promptly make such inspection and, when the Architect finds the Work acceptable under the Contract Documents and the Contract fully performed, the Architect will promptly issue a final Certificate for Payment stating that to the best of the Architect's knowledge, information and belief, and on the basis of the Architect's on-site visits and inspections, the Work has been completed in accordance with terms and conditions of the Contract Documents and that the entire balance found to be due the Contractor and noted in the final Certificate is due and payable. The Architect's final Certificate for Payment will constitute a further representation that conditions listed in Section 9.10.2 as precedent to the Contractor's being entitled to final payment have been fulfilled.

§ 9.10.2 Neither final payment nor any remaining retained percentage shall become due until the Contractor submits to the Architect (1) an affidavit that payrolls, bills for materials and equipment, and other indebtedness connected with the Work for which the Owner or the Owner's property might be responsible or encumbered (less amounts withheld by Owner) have been paid or otherwise satisfied, (2) a certificate evidencing that insurance required by the Contract Documents to remain in force after final payment is currently in effect and will not be canceled or allowed to expire until at least 30 days' prior written notice has been given to the Owner, (3) a written statement that the Contractor knows of no substantial reason that the insurance will not be renewable to cover the period required by the Contract Documents, (4) consent of surety, if any, to final payment and (5), if required by the Owner, other data establishing payment or satisfaction of obligations, such as receipts, releases and waivers of liens, claims, security interests or encumbrances arising out of the Contract, to the extent and in such form as may be designated by the Owner. If a Subcontractor refuses to furnish a release or waiver required by the Owner, the Contractor may furnish a bond satisfactory to the Owner to indemnify the Owner against such lien. If such lien remains unsatisfied after payments are made, the Contractor shall refund to the Owner all money that the Owner may be compelled to pay in discharging such lien, including all costs and reasonable attorneys' fees.

§ 9.10.3 If, after Substantial Completion of the Work, final completion thereof is materially delayed through no fault of the Contractor or by issuance of Change Orders affecting final completion, and the Architect so confirms, the Owner shall, upon application by the Contractor and certification by the Architect, and without terminating the Contract, make payment of the balance due for that portion of the Work fully completed and accepted. If the remaining balance for Work not fully completed or corrected is less than retainage stipulated in the Contract Documents, and if bonds have been furnished, the written consent of surety to payment of the balance due for that portion of the Work fully completed and accepted shall be submitted by the Contractor to the Architect prior to certification of such payment. Such payment shall be made under terms and conditions governing final payment, except that it shall not constitute a waiver of claims.

§ 9.10.4 The making of final payment shall constitute a waiver of Claims by the Owner except those arising from

.1 liens, Claims, security interests or encumbrances arising out of the Contract and unsettled;
.2 failure of the Work to comply with the requirements of the Contract Documents; or
.3 terms of special warranties required by the Contract Documents.

§ 9.10.5 Acceptance of final payment by the Contractor, a Subcontractor or material supplier shall constitute a waiver of claims by that payee except those previously made in writing and identified by that payee as unsettled at the time of final Application for Payment.

ARTICLE 10 PROTECTION OF PERSONS AND PROPERTY

§ 10.1 SAFETY PRECAUTIONS AND PROGRAMS

The Contractor shall be responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the performance of the Contract.

§ 10.2 SAFETY OF PERSONS AND PROPERTY

§ 10.2.1 The Contractor shall take reasonable precautions for safety of, and shall provide reasonable protection to prevent damage, injury or loss to

.1 employees on the Work and other persons who may be affected thereby;
.2 the Work and materials and equipment to be incorporated therein, whether in storage on or off the site, under care, custody or control of the Contractor or the Contractor's Subcontractors or Sub-subcontractors; and
.3 other property at the site or adjacent thereto, such as trees, shrubs, lawns, walks, pavements, roadways, structures and utilities not designated for removal, relocation or replacement in the course of construction.

§ 10.2.2 The Contractor shall comply with and give notices required by applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities bearing on safety of persons or property or their protection from damage, injury or loss.

§ 10.2.3 The Contractor shall erect and maintain, as required by existing conditions and performance of the Contract, reasonable safeguards for safety and protection, including posting danger signs and other warnings against hazards, promulgating safety regulations and notifying owners and users of adjacent sites and utilities.

§ 10.2.4 When use or storage of explosives or other hazardous materials or equipment or unusual methods are necessary for execution of the Work, the Contractor shall exercise utmost care and carry on such activities under supervision of properly qualified personnel.

§ 10.2.5 The Contractor shall promptly remedy damage and loss (other than damage or loss insured under property insurance required by the Contract Documents) to property referred to in Sections 10.2.1.2 and 10.2.1.3 caused in whole or in part by the Contractor, a Subcontractor, a Sub-subcontractor, or anyone directly or indirectly employed by any of them, or by anyone for whose acts they may be liable and for which the Contractor is responsible under Sections 10.2.1.2 and 10.2.1.3, except damage or loss attributable to acts or omissions of the Owner or Architect or anyone directly or indirectly employed by either of them, or by anyone for whose acts either of them may be liable, and not attributable to the fault or negligence of the Contractor. The foregoing obligations of the Contractor are in addition to the Contractor's obligations under Section 3.18.

§ 10.2.6 The Contractor shall designate a responsible member of the Contractor's organization at the site whose duty shall be the prevention of accidents. This person shall be the Contractor's superintendent unless otherwise designated by the Contractor in writing to the Owner and Architect.

§ 10.2.7 The Contractor shall not permit any part of the construction or site to be loaded so as to cause damage or create an unsafe condition.

§ 10.2.8 INJURY OR DAMAGE TO PERSON OR PROPERTY
If either party suffers injury or damage to person or property because of an act or omission of the other party, or of others for whose acts such party is legally responsible, written notice of such injury or damage, whether or not insured, shall be given to the other party within a reasonable time not exceeding 21 days after discovery. The notice shall provide sufficient detail to enable the other party to investigate the matter.

§ 10.3 HAZARDOUS MATERIALS
§ 10.3.1 The Contractor is responsible for compliance with any requirements included in the Contract Documents regarding hazardous materials. If the Contractor encounters a hazardous material or substance not addressed in the Contract Documents and if reasonable precautions will be inadequate to prevent foreseeable bodily injury or death to persons resulting from a material or substance, including but not limited to asbestos or polychlorinated biphenyl (PCB), encountered on the site by the Contractor, the Contractor shall, upon recognizing the condition, immediately stop Work in the affected area and report the condition to the Owner and Architect in writing.

§ 10.3.2 Upon receipt of the Contractor's written notice, the Owner shall obtain the services of a licensed laboratory to verify the presence or absence of the material or substance reported by the Contractor and, in the event such material or substance is found to be present, to cause it to be rendered harmless. Unless otherwise required by the Contract Documents, the Owner shall furnish in writing to the Contractor and Architect the names and qualifications of persons or entities who are to perform tests verifying the presence or absence of such material or substance or who are to perform the task of removal or safe containment of such material or substance. The Contractor and the Architect will promptly reply to the Owner in writing stating whether or not either has reasonable objection to the persons or entities proposed by the Owner. If either the Contractor or Architect has an objection to a person or entity proposed by the Owner, the Owner shall propose another to whom the Contractor and the Architect have no reasonable objection. When the material or substance has been rendered harmless, Work in the affected area shall resume upon written agreement of the Owner and Contractor. By Change Order, the Contract Time shall be extended appropriately and the Contract Sum shall be increased in the amount of the Contractor's reasonable additional costs of shut-down, delay and start-up.

§ 10.3.3 To the fullest extent permitted by law, the Owner shall indemnify and hold harmless the Contractor, Subcontractors, Architect, Architect's consultants and agents and employees of any of them from and against claims, damages, losses and expenses, including but not limited to attorneys' fees, arising out of or resulting from performance of the Work in the affected area if in fact the material or substance presents the risk of bodily injury or death as described in Section 10.3.1 and has not been rendered harmless, provided that such claim, damage, loss or expense is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself), except to the extent that such damage, loss or expense is due to the fault or negligence of the party seeking indemnity.

§ 10.3.4 The Owner shall not be responsible under this Section 10.3 for materials or substances the Contractor brings to the site unless such materials or substances are required by the Contract Documents. The Owner shall be responsible for materials or substances required by the Contract Documents, except to the extent of the Contractor's fault or negligence in the use and handling of such materials or substances.

§ 10.3.5 The Contractor shall indemnify the Owner for the cost and expense the Owner incurs (1) for remediation of a material or substance the Contractor brings to the site and negligently handles, or (2) where the Contractor fails to perform its obligations under Section 10.3.1, except to the extent that the cost and expense are due to the Owner's fault or negligence.

§ 10.3.6 If, without negligence on the part of the Contractor, the Contractor is held liable by a government agency for the cost of remediation of a hazardous material or substance solely by reason of performing Work as required by the Contract Documents, the Owner shall indemnify the Contractor for all cost and expense thereby incurred.

§ 10.4 EMERGENCIES

In an emergency affecting safety of persons or property, the Contractor shall act, at the Contractor's discretion, to prevent threatened damage, injury or loss. Additional compensation or extension of time claimed by the Contractor on account of an emergency shall be determined as provided in Article 15 and Article 7.

ARTICLE 11 INSURANCE AND BONDS

§ 11.1 CONTRACTOR'S LIABILITY INSURANCE

§ 11.1.1 The Contractor shall purchase from and maintain in a company or companies lawfully authorized to do business in the jurisdiction in which the Project is located such insurance as will protect the Contractor from claims set forth below which may arise out of or result from the Contractor's operations and completed operations under the Contract and for which the Contractor may be legally liable, whether such operations be by the Contractor or by a Subcontractor or by anyone directly or indirectly employed by any of them, or by anyone for whose acts any of them may be liable:

.1 Claims under workers' compensation, disability benefit and other similar employee benefit acts that are applicable to the Work to be performed;

.2 Claims for damages because of bodily injury, occupational sickness or disease, or death of the Contractor's employees;

.3 Claims for damages because of bodily injury, sickness or disease, or death of any person other than the Contractor's employees;

.4 Claims for damages insured by usual personal injury liability coverage;

.5 Claims for damages, other than to the Work itself, because of injury to or destruction of tangible property, including loss of use resulting therefrom;

.6 Claims for damages because of bodily injury, death of a person or property damage arising out of ownership, maintenance or use of a motor vehicle;

.7 Claims for bodily injury or property damage arising out of completed operations; and

.8 Claims involving contractual liability insurance applicable to the Contractor's obligations under Section 3.18.

§ 11.1.2 The insurance required by Section 11.1.1 shall be written for not less than limits of liability specified in the Contract Documents or required by law, whichever coverage is greater. Coverages, whether written on an occurrence or claims-made basis, shall be maintained without interruption from the date of commencement of the Work until the date of final payment and termination of any coverage required to be maintained after final payment, and, with respect to the Contractor's completed operations coverage, until the expiration of the period for correction of Work or for such other period for maintenance of completed operations coverage as specified in the Contract Documents.

§ 11.1.3 Certificates of insurance acceptable to the Owner shall be filed with the Owner prior to commencement of the Work and thereafter upon renewal or replacement of each required policy of insurance. These certificates and the insurance policies required by this Section 11.1 shall contain a provision that coverages afforded under the policies will not be canceled or allowed to expire until at least 30 days' prior written notice has been given to the Owner. An additional certificate evidencing continuation of liability coverage, including coverage for completed operations, shall be submitted with the final Application for Payment as required by Section 9.10.2 and thereafter upon renewal or replacement of such coverage until the expiration of the time required by Section 11.1.2. Information concerning reduction of coverage on account of revised limits or claims paid under the General Aggregate, or both, shall be furnished by the Contractor with reasonable promptness.

§ 11.1.4 The Contractor shall cause the commercial liability coverage required by the Contract Documents to include (1) the Owner, the Architect and the Architect's consultants as additional insureds for claims caused in whole or in part by the Contractor's negligent acts or omissions during the Contractor's operations; and (2) the Owner as an additional insured for claims caused in whole or in part by the Contractor's negligent acts or omissions during the Contractor's completed operations.

§ 11.2 OWNER'S LIABILITY INSURANCE

The Owner shall be responsible for purchasing and maintaining the Owner's usual liability insurance.

§ 11.3 PROPERTY INSURANCE

§ 11.3.1 Unless otherwise provided, the Owner shall purchase and maintain, in a company or companies lawfully authorized to do business in the jurisdiction in which the Project is located, property insurance written on a builder's

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risk "all-risk" or equivalent policy form in the amount of the initial Contract Sum, plus value of subsequent Contract Modifications and cost of materials supplied or installed by others, comprising total value for the entire Project at the site on a replacement cost basis without optional deductibles. Such property insurance shall be maintained, unless otherwise provided in the Contract Documents or otherwise agreed in writing by all persons and entities who are beneficiaries of such insurance, until final payment has been made as provided in Section 9.10 or until no person or entity other than the Owner has an insurable interest in the property required by this Section 11.3 to be covered, whichever is later. This insurance shall include interests of the Owner, the Contractor, Subcontractors and Sub-subcontractors in the Project.

§ 11.3.1.1 Property insurance shall be on an "all-risk" or equivalent policy form and shall include, without limitation, insurance against the perils of fire (with extended coverage) and physical loss or damage including, without duplication of coverage, theft, vandalism, malicious mischief, collapse, earthquake, flood, 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.

§ 11.3.1.2 If the Owner does not intend to purchase such property insurance required by the Contract and with all of the coverages in the amount described above, the Owner shall so inform the Contractor in writing prior to commencement of the Work. The Contractor may then effect insurance that will protect the interests of the Contractor, Subcontractors and Sub-subcontractors in the Work, and by appropriate Change Order the cost thereof shall be charged to the Owner. If the Contractor is damaged by the failure or neglect of the Owner to purchase or maintain insurance as described above, without so notifying the Contractor in writing, then the Owner shall bear all reasonable costs properly attributable thereto.

§ 11.3.1.3 If the property insurance requires deductibles, the Owner shall pay costs not covered because of such deductibles.

§ 11.3.1.4 This property insurance shall cover portions of the Work stored off the site, and also portions of the Work in transit.

§ 11.3.1.5 Partial occupancy or use in accordance with Section 9.9 shall not commence until the insurance company or companies providing property insurance have consented to such partial occupancy or use by endorsement or otherwise. The Owner and the Contractor shall take reasonable steps to obtain consent of the insurance company or companies and shall, without mutual written consent, take no action with respect to partial occupancy or use that would cause cancellation, lapse or reduction of insurance.

§ 11.3.2 BOILER AND MACHINERY INSURANCE

The Owner shall purchase and maintain boiler and machinery insurance required by the Contract Documents or by law, which shall specifically cover such insured objects during installation and until final acceptance by the Owner; this insurance shall include interests of the Owner, Contractor, Subcontractors and Sub-subcontractors in the Work, and the Owner and Contractor shall be named insureds.

§ 11.3.3 LOSS OF USE INSURANCE

The Owner, at the Owner's option, may purchase and maintain such insurance as will insure the Owner against loss of use of the Owner's property due to fire or other hazards, however caused. The Owner waives all rights of action against the Contractor for loss of use of the Owner's property, including consequential losses due to fire or other hazards however caused.

§ 11.3.4 If the Contractor requests in writing that insurance for risks other than those described herein or other special causes of loss be included in the property insurance policy, the Owner shall, if possible, include such insurance, and the cost thereof shall be charged to the Contractor by appropriate Change Order.

§ 11.3.5 If during the Project construction period the Owner insures properties, real or personal or both, at or adjacent to the site by property insurance under policies separate from those insuring the Project, or if after final payment property insurance is to be provided on the completed Project through a policy or policies other than those insuring the Project during the construction period, the Owner shall waive all rights in accordance with the terms of Section 11.3.7 for damages caused by fire or other causes of loss covered by this separate property insurance. All separate policies shall provide this waiver of subrogation by endorsement or otherwise.

§ 11.3.6 Before an exposure to loss may occur, the Owner shall file with the Contractor a copy of each policy that includes insurance coverages required by this Section 11.3. Each policy shall contain all generally applicable conditions, definitions, exclusions and endorsements related to this Project. Each policy shall contain a provision that the policy will not be canceled or allowed to expire, and that its limits will not be reduced, until at least 30 days' prior written notice has been given to the Contractor.

§ 11.3.7 WAIVERS OF SUBROGATION

The Owner and Contractor waive all rights against (1) each other and any of their subcontractors, sub-subcontractors, agents and employees, each of the other, and (2) the Architect, Architect's consultants, separate contractors described in Article 6, if any, and any of their subcontractors, sub-subcontractors, agents and employees, for damages caused by fire or other causes of loss to the extent covered by property insurance obtained pursuant to this Section 11.3 or other property insurance applicable to the Work, except such rights as they have to proceeds of such insurance held by the Owner as fiduciary. The Owner or Contractor, as appropriate, shall require of the Architect, Architect's consultants, separate contractors described in Article 6, if any, and the subcontractors, sub-subcontractors, agents and employees of any of them, by appropriate agreements, written where legally required for validity, similar waivers each in favor of other parties enumerated herein. The policies shall provide such waivers of subrogation by endorsement or otherwise. A waiver of subrogation shall be effective as to a person or entity even though that person or entity would otherwise have a duty of indemnification, contractual or otherwise, did not pay the insurance premium directly or indirectly, and whether or not the person or entity had an insurable interest in the property damaged.

§ 11.3.8 A loss insured under the Owner's property insurance shall be adjusted by the Owner as fiduciary and made payable to the Owner as fiduciary for the insureds, as their interests may appear, subject to requirements of any applicable mortgagee clause and of Section 11.3.10. The Contractor shall pay Subcontractors their just shares of insurance proceeds received by the Contractor, and by appropriate agreements, written where legally required for validity, shall require Subcontractors to make payments to their Sub-subcontractors in similar manner.

§ 11.3.9 If required in writing by a party in interest, the Owner as fiduciary shall, upon occurrence of an insured loss, give bond for proper performance of the Owner's duties. The cost of required bonds shall be charged against proceeds received as fiduciary. The Owner shall deposit in a separate account proceeds so received, which the Owner shall distribute in accordance with such agreement as the parties in interest may reach, or as determined in accordance with the method of binding dispute resolution selected in the Agreement between the Owner and Contractor. If after such loss no other special agreement is made and unless the Owner terminates the Contract for convenience, replacement of damaged property shall be performed by the Contractor after notification of a Change in the Work in accordance with Article 7.

§ 11.3.10 The Owner as fiduciary shall have power to adjust and settle a loss with insurers unless one of the parties in interest shall object in writing within five days after occurrence of loss to the Owner's exercise of this power; if such objection is made, the dispute shall be resolved in the manner selected by the Owner and Contractor as the method of binding dispute resolution in the Agreement. If the Owner and Contractor have selected arbitration as the method of binding dispute resolution, the Owner as fiduciary shall make settlement with insurers or, in the case of a dispute over distribution of insurance proceeds, in accordance with the directions of the arbitrators.

§ 11.4 PERFORMANCE BOND AND PAYMENT BOND

§ 11.4.1 The Owner shall have the right to require the Contractor to furnish bonds covering faithful performance of the Contract and payment of obligations arising thereunder as stipulated in bidding requirements or specifically required in the Contract Documents on the date of execution of the Contract.

§ 11.4.2 Upon the request of any person or entity appearing to be a potential beneficiary of bonds covering payment of obligations arising under the Contract, the Contractor shall promptly furnish a copy of the bonds or shall authorize a copy to be furnished.

ARTICLE 12 UNCOVERING AND CORRECTION OF WORK

§ 12.1 UNCOVERING OF WORK

§ 12.1.1 If a portion of the Work is covered contrary to the Architect's request or to requirements specifically expressed in the Contract Documents, it must, if requested in writing by the Architect, be uncovered for the Architect's examination and be replaced at the Contractor's expense without change in the Contract Time.

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§ 12.1.2 If a portion of the Work has been covered that the Architect has not specifically requested to examine prior to its being covered, the Architect may request to see such Work and it shall be uncovered by the Contractor. If such Work is in accordance with the Contract Documents, costs of uncovering and replacement shall, by appropriate Change Order, be at the Owner's expense. If such Work is not in accordance with the Contract Documents, such costs and the cost of correction shall be at the Contractor's expense unless the condition was caused by the Owner or a separate contractor in which event the Owner shall be responsible for payment of such costs.

§ 12.2 CORRECTION OF WORK

§ 12.2.1 BEFORE OR AFTER SUBSTANTIAL COMPLETION

The Contractor shall promptly correct Work rejected by the Architect or failing to conform to the requirements of the Contract Documents, whether discovered before or after Substantial Completion and whether or not fabricated, installed or completed. Costs of correcting such rejected Work, including additional testing and inspections, the cost of uncovering and replacement, and compensation for the Architect's services and expenses made necessary thereby, shall be at the Contractor's expense.

§ 12.2.2 AFTER SUBSTANTIAL COMPLETION

§ 12.2.2.1 In addition to the Contractor's obligations under Section 3.5, if, within one year after the date of Substantial Completion of the Work or designated portion thereof or after the date for commencement of warranties established under Section 9.9.1, or by terms of an applicable special warranty required by the Contract Documents, any of the Work is found to be not in accordance with the requirements of the Contract Documents, the Contractor shall correct it promptly after receipt of written notice from the Owner to do so unless the Owner has previously given the Contractor a written acceptance of such condition. The Owner shall give such notice promptly after discovery of the condition. During the one-year period for correction of Work, if the Owner fails to notify the Contractor and give the Contractor an opportunity to make the correction, the Owner waives the rights to require correction by the Contractor and to make a claim for breach of warranty. If the Contractor fails to correct nonconforming Work within a reasonable time during that period after receipt of notice from the Owner or Architect, the Owner may correct it in accordance with Section 2.4.

§ 12.2.2.2 The one-year period for correction of Work shall be extended with respect to portions of Work first performed after Substantial Completion by the period of time between Substantial Completion and the actual completion of that portion of the Work.

§ 12.2.2.3 The one-year period for correction of Work shall not be extended by corrective Work performed by the Contractor pursuant to this Section 12.2.

§ 12.2.3 The Contractor shall remove from the site portions of the Work that are not in accordance with the requirements of the Contract Documents and are neither corrected by the Contractor nor accepted by the Owner.

§ 12.2.4 The Contractor shall bear the cost of correcting destroyed or damaged construction, whether completed or partially completed, of the Owner or separate contractors caused by the Contractor's correction or removal of Work that is not in accordance with the requirements of the Contract Documents.

§ 12.2.5 Nothing contained in this Section 12.2 shall be construed to establish a period of limitation with respect to other obligations the Contractor has under the Contract Documents. Establishment of the one-year period for correction of Work as described in Section 12.2.2 relates only to the specific obligation of the Contractor to correct the Work, and has no relationship to the time within which the obligation to comply with the Contract Documents may be sought to be enforced, nor to the time within which proceedings may be commenced to establish the Contractor's liability with respect to the Contractor's obligations other than specifically to correct the Work.

§ 12.3 ACCEPTANCE OF NONCONFORMING WORK

If the Owner prefers to accept Work that is not in accordance with the requirements of the Contract Documents, the Owner may do so instead of requiring its removal and correction, in which case the Contract Sum will be reduced as appropriate and equitable. Such adjustment shall be effected whether or not final payment has been made.

ARTICLE 13 MISCELLANEOUS PROVISIONS

§ 13.1 GOVERNING LAW

The Contract shall be governed by the law of the place where the Project is located except that, if the parties have selected arbitration as the method of binding dispute resolution, the Federal Arbitration Act shall govern Section 15.4.

§ 13.2 SUCCESSORS AND ASSIGNS

§ 13.2.1 The Owner and Contractor respectively bind themselves, their partners, successors, assigns and legal representatives to covenants, agreements and obligations contained in the Contract Documents. Except as provided in Section 13.2.2, neither party to the Contract shall assign the Contract as a whole without written consent of the other. If either party attempts to make such an assignment without such consent, that party shall nevertheless remain legally responsible for all obligations under the Contract.

§ 13.2.2 The Owner may, without consent of the Contractor, assign the Contract to a lender providing construction financing for the Project, if the lender assumes the Owner's rights and obligations under the Contract Documents. The Contractor shall execute all consents reasonably required to facilitate such assignment.

§ 13.3 WRITTEN NOTICE

Written notice shall be deemed to have been duly served if delivered in person to the individual, to a member of the firm or entity, or to an officer of the corporation for which it was intended; or if delivered at, or sent by registered or certified mail or by courier service providing proof of delivery to, the last business address known to the party giving notice.

§ 13.4 RIGHTS AND REMEDIES

§ 13.4.1 Duties and obligations imposed by the Contract Documents and rights and remedies available thereunder shall be in addition to and not a limitation of duties, obligations, rights and remedies otherwise imposed or available by law.

§ 13.4.2 No action or failure to act by the Owner, Architect or Contractor shall constitute a waiver of a right or duty afforded them under the Contract, nor shall such action or failure to act constitute approval of or acquiescence in a breach there under, except as may be specifically agreed in writing.

§ 13.5 TESTS AND INSPECTIONS

§ 13.5.1 Tests, inspections and approvals of portions of the Work shall be made as required by the Contract Documents and by applicable laws, statutes, ordinances, codes, rules and regulations or lawful orders of public authorities. Unless otherwise provided, the Contractor shall make arrangements for such tests, inspections and approvals with an independent testing laboratory or entity acceptable to the Owner, or with the appropriate public authority, and shall bear all related costs of tests, inspections and approvals. The Contractor shall give the Architect timely notice of when and where tests and inspections are to be made so that the Architect may be present for such procedures. The Owner shall bear costs of (1) tests, inspections or approvals that do not become requirements until after bids are received or negotiations concluded, and (2) tests, inspections or approvals where building codes or applicable laws or regulations prohibit the Owner from delegating their cost to the Contractor.

§ 13.5.2 If the Architect, Owner or public authorities having jurisdiction determine that portions of the Work require additional testing, inspection or approval not included under Section 13.5.1, the Architect will, upon written authorization from the Owner, instruct the Contractor to make arrangements for such additional testing, inspection or approval by an entity acceptable to the Owner, and the Contractor shall give timely notice to the Architect of when and where tests and inspections are to be made so that the Architect may be present for such procedures. Such costs, except as provided in Section 13.5.3, shall be at the Owner's expense.

§ 13.5.3 If such procedures for testing, inspection or approval under Sections 13.5.1 and 13.5.2 reveal failure of the portions of the Work to comply with requirements established by the Contract Documents, all costs made necessary by such failure including those of repeated procedures and compensation for the Architect's services and expenses shall be at the Contractor's expense.

§ 13.5.4 Required certificates of testing, inspection or approval shall, unless otherwise required by the Contract Documents, be secured by the Contractor and promptly delivered to the Architect.

§ 13.5.5 If the Architect is to observe tests, inspections or approvals required by the Contract Documents, the Architect will do so promptly and, where practicable, at the normal place of testing.

§ 13.5.6 Tests or inspections conducted pursuant to the Contract Documents shall be made promptly to avoid unreasonable delay in the Work.

§ 13.6 INTEREST

Payments due and unpaid under the Contract Documents shall bear interest from the date payment is due at such rate as the parties may agree upon in writing or, in the absence thereof, at the legal rate prevailing from time to time at the place where the Project is located.

§ 13.7 TIME LIMITS ON CLAIMS

The Owner and Contractor shall commence all claims and causes of action, whether in contract, tort, breach of warranty or otherwise, against the other arising out of or related to the Contract in accordance with the requirements of the final dispute resolution method selected in the Agreement within the time period specified by applicable law, but in any case not more than 10 years after the date of Substantial Completion of the Work. The Owner and Contractor waive all claims and causes of action not commenced in accordance with this Section 13.7.

ARTICLE 14 TERMINATION OR SUSPENSION OF THE CONTRACT

§ 14.1 TERMINATION BY THE CONTRACTOR

§ 14.1.1 The Contractor may terminate the Contract if the Work is stopped for a period of 30 consecutive days through no act or fault of the Contractor or a Subcontractor, Sub-subcontractor or their agents or employees or any other persons or entities performing portions of the Work under direct or indirect contract with the Contractor, for any of the following reasons:

.1 Issuance of an order of a court or other public authority having jurisdiction that requires all Work to be stopped;

.2 An act of government, such as a declaration of national emergency that requires all Work to be stopped;

.3 Because the Architect has not issued a Certificate for Payment and has not notified the Contractor of the reason for withholding certification as provided in Section 9.4.1, or because the Owner has not made payment on a Certificate for Payment within the time stated in the Contract Documents; or

.4 The Owner has failed to furnish to the Contractor promptly, upon the Contractor's request, reasonable evidence as required by Section 2.2.1.

§ 14.1.2 The Contractor may terminate the Contract if, through no act or fault of the Contractor or a Subcontractor, Sub-subcontractor or their agents or employees or any other persons or entities performing portions of the Work under direct or indirect contract with the Contractor, repeated suspensions, delays or interruptions of the entire Work by the Owner as described in Section 14.3 constitute in the aggregate more than 100 percent of the total number of days scheduled for completion, or 120 days in any 365-day period, whichever is less.

§ 14.1.3 If one of the reasons described in Section 14.1.1 or 14.1.2 exists, the Contractor may, upon seven days' written notice to the Owner and Architect, terminate the Contract and recover from the Owner payment for Work executed, including reasonable overhead and profit, costs incurred by reason of such termination, and damages.

§ 14.1.4 If the Work is stopped for a period of 60 consecutive days through no act or fault of the Contractor or a Subcontractor or their agents or employees or any other persons performing portions of the Work under contract with the Contractor because the Owner has repeatedly failed to fulfill the Owner's obligations under the Contract Documents with respect to matters important to the progress of the Work, the Contractor may, upon seven additional days' written notice to the Owner and the Architect, terminate the Contract and recover from the Owner as provided in Section 14.1.3.

§ 14.2 TERMINATION BY THE OWNER FOR CAUSE

§ 14.2.1 The Owner may terminate the Contract if the Contractor

.1 repeatedly refuses or fails to supply enough properly skilled workers or proper materials;

.2 fails to make payment to Subcontractors for materials or labor in accordance with the respective agreements between the Contractor and the Subcontractors;

.3 repeatedly disregards applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of a public authority; or

.4 otherwise is guilty of substantial breach of a provision of the Contract Documents.

§ 14.2.2 When any of the above reasons exist, the Owner, upon certification by the Initial Decision Maker that sufficient cause exists to justify such action, may without prejudice to any other rights or remedies of the Owner and after giving the Contractor and the Contractor's surety, if any, seven days' written notice, terminate employment of the Contractor and may, subject to any prior rights of the surety:

.1 Exclude the Contractor from the site and take possession of all materials, equipment, tools, and construction equipment and machinery thereon owned by the Contractor;

.2 Accept assignment of subcontracts pursuant to Section 5.4; and

.3 Finish the Work by whatever reasonable method the Owner may deem expedient. Upon written request of the Contractor, the Owner shall furnish to the Contractor a detailed accounting of the costs incurred by the Owner in finishing the Work.

§ 14.2.3 When the Owner terminates the Contract for one of the reasons stated in Section 14.2.1, the Contractor shall not be entitled to receive further payment until the Work is finished.

§ 14.2.4 If the unpaid balance of the Contract Sum exceeds costs of finishing the Work, including compensation for the Architect's services and expenses made necessary thereby, and other damages incurred by the Owner and not expressly waived, such excess shall be paid to the Contractor. If such costs and damages exceed the unpaid balance, the Contractor shall pay the difference to the Owner. The amount to be paid to the Contractor or Owner, as the case may be, shall be certified by the Initial Decision Maker, upon application, and this obligation for payment shall survive termination of the Contract.

§ 14.3 SUSPENSION BY THE OWNER FOR CONVENIENCE

§ 14.3.1 The Owner may, without cause, order the Contractor in writing to suspend, delay or interrupt the Work in whole or in part for such period of time as the Owner may determine.

§ 14.3.2 The Contract Sum and Contract Time shall be adjusted for increases in the cost and time caused by suspension, delay or interruption as described in Section 14.3.1. Adjustment of the Contract Sum shall include profit. No adjustment shall be made to the extent

.1 that performance is, was or would have been so suspended, delayed or interrupted by another cause for which the Contractor is responsible; or

.2 that an equitable adjustment is made or denied under another provision of the Contract.

§ 14.4 TERMINATION BY THE OWNER FOR CONVENIENCE

§ 14.4.1 The Owner may, at any time, terminate the Contract for the Owner's convenience and without cause.

§ 14.4.2 Upon receipt of written notice from the Owner of such termination for the Owner's convenience, the Contractor shall

.1 cease operations as directed by the Owner in the notice;

.2 take actions necessary, or that the Owner may direct, for the protection and preservation of the Work; and

.3 except for Work directed to be performed prior to the effective date of termination stated in the notice, terminate all existing subcontracts and purchase orders and enter into no further subcontracts and purchase orders.

§ 14.4.3 In case of such termination for the Owner's convenience, the Contractor shall be entitled to receive payment for Work executed, and costs incurred by reason of such termination, along with reasonable overhead and profit on the Work not executed.

ARTICLE 15 CLAIMS AND DISPUTES

§ 15.1 CLAIMS

§ 15.1.1 DEFINITION

A Claim is a demand or assertion by one of the parties seeking, as a matter of right, payment of money, or other relief with respect to the terms of the Contract. The term "Claim" also includes other disputes and matters in question between the Owner and Contractor arising out of or relating to the Contract. The responsibility to substantiate Claims shall rest with the party making the Claim.

§ 15.1.2 NOTICE OF CLAIMS

Claims by either the Owner or Contractor must be initiated by written notice to the other party and to the Initial Decision Maker with a copy sent to the Architect, if the Architect is not serving as the Initial Decision Maker.

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Claims by either party must be initiated within 21 days after occurrence of the event giving rise to such Claim or within 21 days after the claimant first recognizes the condition giving rise to the Claim, whichever is later.

§ 15.1.3 CONTINUING CONTRACT PERFORMANCE

Pending final resolution of a Claim, except as otherwise agreed in writing or as provided in Section 9.7 and Article 14, the Contractor shall proceed diligently with performance of the Contract and the Owner shall continue to make payments in accordance with the Contract Documents. The Architect will prepare Change Orders and issue Certificates for Payment in accordance with the decisions of the Initial Decision Maker.

§ 15.1.4 CLAIMS FOR ADDITIONAL COST

If the Contractor wishes to make a Claim for an increase in the Contract Sum, written notice as provided herein shall be given before proceeding to execute the Work. Prior notice is not required for Claims relating to an emergency endangering life or property arising under Section 10.4.

§ 15.1.5 CLAIMS FOR ADDITIONAL TIME

§ 15.1.5.1 If the Contractor wishes to make a Claim for an increase in the Contract Time, written notice as provided herein shall be given. The Contractor's Claim shall include an estimate of cost and of probable effect of delay on progress of the Work. In the case of a continuing delay, only one Claim is necessary.

§ 15.1.5.2 If adverse weather conditions are the basis for a Claim for additional time, such Claim shall be documented by data substantiating that weather conditions were abnormal for the period of time, could not have been reasonably anticipated and had an adverse effect on the scheduled construction.

§ 15.1.6 CLAIMS FOR CONSEQUENTIAL DAMAGES

The Contractor and Owner waive Claims against each other for consequential damages arising out of or relating to this Contract. This mutual waiver includes

.1 damages incurred by the Owner for rental expenses, for losses of use, income, profit, financing, business and reputation, and for loss of management or employee productivity or of the services of such persons; and

.2 damages incurred by the Contractor for principal office expenses including the compensation of personnel stationed there, for losses of financing, business and reputation, and for loss of profit except anticipated profit arising directly from the Work.

This mutual waiver is applicable, without limitation, to all consequential damages due to either party's termination in accordance with Article 14. Nothing contained in this Section 15.1.6 shall be deemed to preclude an award of liquidated damages, when applicable, in accordance with the requirements of the Contract Documents.

§ 15.2 INITIAL DECISION

§ 15.2.1 Claims, excluding those arising under Sections 10.3, 10.4, 11.3.9, and 11.3.10, shall be referred to the Initial Decision Maker for initial decision. The Architect will serve as the Initial Decision Maker, unless otherwise indicated in the Agreement. Except for those Claims excluded by this Section 15.2.1, an initial decision shall be required as a condition precedent to mediation of any Claim arising prior to the date final payment is due, unless 30 days have passed after the Claim has been referred to the Initial Decision Maker with no decision having been rendered. Unless the Initial Decision Maker and all affected parties agree, the Initial Decision Maker will not decide disputes between the Contractor and persons or entities other than the Owner.

§ 15.2.2 The Initial Decision Maker will review Claims and within ten days of the receipt of a Claim take one or more of the following actions: (1) request additional supporting data from the claimant or a response with supporting data from the other party, (2) reject the Claim in whole or in part, (3) approve the Claim, (4) suggest a compromise, or (5) advise the parties that the Initial Decision Maker is unable to resolve the Claim if the Initial Decision Maker lacks sufficient information to evaluate the merits of the Claim or if the Initial Decision Maker concludes that, in the Initial Decision Maker's sole discretion, it would be inappropriate for the Initial Decision Maker to resolve the Claim.

§ 15.2.3 In evaluating Claims, the Initial Decision Maker may, but shall not be obligated to, consult with or seek information from either party or from persons with special knowledge or expertise who may assist the Initial Decision Maker in rendering a decision. The Initial Decision Maker may request the Owner to authorize retention of such persons at the Owner's expense.

§ 15.2.4 If the Initial Decision Maker requests a party to provide a response to a Claim or to furnish additional supporting data, such party shall respond, within ten days after receipt of such request, and shall either (1) provide a response on the requested supporting data, (2) advise the Initial Decision Maker when the response or supporting data will be furnished or (3) advise the Initial Decision Maker that no supporting data will be furnished. Upon receipt of the response or supporting data, if any, the Initial Decision Maker will either reject or approve the Claim in whole or in part.

§ 15.2.5 The Initial Decision Maker will render an initial decision approving or rejecting the Claim, or indicating that the Initial Decision Maker is unable to resolve the Claim. This initial decision shall (1) be in writing; (2) state the reasons therefor; and (3) notify the parties and the Architect, if the Architect is not serving as the Initial Decision Maker, of any change in the Contract Sum or Contract Time or both. The initial decision shall be final and binding on the parties but subject to mediation and, if the parties fail to resolve their dispute through mediation, to binding dispute resolution.

§ 15.2.6 Either party may file for mediation of an initial decision at any time, subject to the terms of Section 15.2.6.1.

§ 15.2.6.1 Either party may, within 30 days from the date of an initial decision, demand in writing that the other party file for mediation within 60 days of the initial decision. If such a demand is made and the party receiving the demand fails to file for mediation within the time required, then both parties waive their rights to mediate or pursue binding dispute resolution proceedings with respect to the initial decision.

§ 15.2.7 In the event of a Claim against the Contractor, the Owner may, but is not obligated to, notify the surety, if any, of the nature and amount of the Claim. If the Claim relates to a possibility of a Contractor's default, the Owner may, but is not obligated to, notify the surety and request the surety's assistance in resolving the controversy.

§ 15.2.8 If a Claim relates to or is the subject of a mechanic's lien, the party asserting such Claim may proceed in accordance with applicable law to comply with the lien notice or filing deadlines.

§ 15.3 MEDIATION

§ 15.3.1 Claims, disputes, or other matters in controversy arising out of or related to the Contract except those waived as provided for in Sections 9.10.4, 9.10.5, and 15.1.6 shall be subject to mediation as a condition precedent to binding dispute resolution.

§ 15.3.2 The parties shall endeavor to resolve their Claims by mediation which, unless the parties mutually agree otherwise, shall be administered by the American Arbitration Association in accordance with its Construction Industry Mediation Procedures in effect on the date of the Agreement. A request for mediation shall be made in writing, delivered to the other party to the Contract, and filed with the person or entity administering the mediation. The request may be made concurrently with the filing of binding dispute resolution proceedings but, in such event, mediation shall proceed in advance of binding dispute resolution proceedings, which shall be stayed pending mediation for a period of 60 days from the date of filing, unless stayed for a longer period by agreement of the parties or court order. If an arbitration is stayed pursuant to this Section 15.3.2, the parties may nonetheless proceed to the selection of the arbitrator(s) and agree upon a schedule for later proceedings.

§ 15.3.3 The parties shall share the mediator's fee and any filing fees equally. The mediation shall be held in the place where the Project is located, unless another location is mutually agreed upon. Agreements reached in mediation shall be enforceable as settlement agreements in any court having jurisdiction thereof.

§ 15.4 ARBITRATION

§ 15.4.1 If the parties have selected arbitration as the method for binding dispute resolution in the Agreement, any Claim subject to, but not resolved by, mediation shall be subject to arbitration which, unless the parties mutually agree otherwise, shall be administered by the American Arbitration Association in accordance with its Construction Industry Arbitration Rules in effect on the date of the Agreement. A demand for arbitration shall be made in writing, delivered to the other party to the Contract, and filed with the person or entity administering the arbitration. The party filing a notice of demand for arbitration must assert in the demand all Claims then known to that party on which arbitration is permitted to be demanded.

§ 15.4.1.1 A demand for arbitration shall be made no earlier than concurrently with the filing of a request for mediation, but in no event shall it be made after the date when the institution of legal or equitable proceedings based on the Claim would be barred by the applicable statute of limitations. For statute of limitations purposes, receipt of a written demand for arbitration by the person or entity administering the arbitration shall constitute the institution of legal or equitable proceedings based on the Claim.

§ 15.4.2 The award rendered by the arbitrator or arbitrators shall be final, and judgment may be entered upon it in accordance with applicable law in any court having jurisdiction thereof.

§ 15.4.3 The foregoing agreement to arbitrate and other agreements to arbitrate with an additional person or entity duly consented to by parties to the Agreement shall be specifically enforceable under applicable law in any court having jurisdiction thereof.

§ 15.4.4 CONSOLIDATION OR JOINDER

§ 15.4.4.1 Either party, at its sole discretion, may consolidate an arbitration conducted under this Agreement with any other arbitration to which it is a party provided that (1) the arbitration agreement governing the other arbitration permits consolidation, (2) the arbitrations to be consolidated substantially involve common questions of law or fact, and (3) the arbitrations employ materially similar procedural rules and methods for selecting arbitrator(s).

§ 15.4.4.2 Either party, at its sole discretion, may include by joinder persons or entities substantially involved in a common question of law or fact whose presence is required if complete relief is to be accorded in arbitration, provided that the party sought to be joined consents in writing to such joinder. Consent to arbitration involving an additional person or entity shall not constitute consent to arbitration of any claim, dispute or other matter in question not described in the written consent.

§ 15.4.4.3 The Owner and Contractor grant to any person or entity made a party to an arbitration conducted under this Section 15.4, whether by joinder or consolidation, the same rights of joinder and consolidation as the Owner and Contractor under this Agreement.

SUPPLEMENTARY CONDITIONS

Amending the General Conditions of the Contract for Construction
AIA Document A201 (2007 edition)

I. SUPPLEMENTARY CONDITIONS

The following addendum supplements, modifies, deletes and/or adds to the General Conditions. Where any Article, Paragraph or subparagraph in the General Conditions is supplemented by one of the following paragraphs, the provisions of such Article, Paragraph, or Subparagraph shall remain in effect and the supplemental provisions shall be considered as added thereto. Where any Article, Paragraph, or subparagraph in the General Conditions is amended, voided or superseded by any of the following paragraphs, the provisions of such Article, Paragraph or subparagraph not so amended, voided, or superseded shall remain in effect.

II. MODIFICATIONS TO VARIOUS ARTICLES OF THE AIA CONDITIONS

ARTICLE 1 GENERAL PROVISIONS

1.1.1 In the first sentence, delete “are enumerated in the Agreement between the Owner and Contractor (hereinafter the Agreement) and” after “The Contract Documents”.

Insert “between the Owner and Contractor (hereinafter the Agreement)” after “consist of the Agreement”.

In the last sentence:

Delete “Unless specifically enumerated in the Agreement”.

Delete “not” after “Contract Documents do”.

Delete “other” after “sample forms,”.

Delete “or” after “or proposal,” and insert “and”.

Delete “bidding requirements” after “relating to” and insert “those documents.”

1.1.8 Delete “Claims” and insert “claims”.

Delete “and certify termination of the Agreement under Section 14.2.2.”.

1.2.1 Add to the end of the sub-section:

All Work mentioned or indicated in the Contract Documents shall be performed by the Contractor as part of this Contract unless it is specifically indicated in the Contract Documents that such Work is to be done by others. Should the Drawings or the Specifications disagree in themselves or with each other, the Contractor shall provide the better quality or greater quantity of Work unless otherwise directed by written addendum to the Contract.

1.2.2 Add to the end of the sentence:

, except that the performance of filed sub-trade work shall comply with the provisions of chapter 149 of the General Laws of the Commonwealth of Massachusetts. The Contractor and all Subcontractors shall refer to all of the Drawings, including those showing primarily the Work of the mechanical, electrical and other specialized trades, and to all of the Sections of the Specifications, and shall perform all Work reasonably inferable therefrom as being necessary to produce the indicated results.

1.2.4 Add the following new sub-sections 1.2.4 to 1.2.11 as follows:
-1.2.11

§ 1.2.4 All indications or notations which apply to one of a number of similar situations, materials or processes shall be deemed to apply to all such situations, materials or processes wherever they appear in the Work, except where a contrary result is clearly indicated by the Contract Documents.

§ 1.2.5 Where codes, standards, requirements and publications of public and private bodies are referred to in the Specifications, references shall be understood to be to the latest revision prior to the date of receiving bids, except where otherwise indicated.

§ 1.2.6 Where no explicit quality or standards for materials or workmanship are established for Work, such Work is to be of good quality for the intended use and consistent with the quality of the surrounding Work and of the construction of the Project generally.

§ 1.2.7 All manufactured articles, materials, and equipment shall be applied, installed, connected, erected, used, cleaned, and conditioned in accordance with the manufacturer's written or printed directions and instructions unless otherwise indicated in the Contract Documents.

§ 1.2.8 The Mechanical, Electrical and Fire Protection Drawings are diagrammatic only, and are not intended to show the alignment, physical

locations or configurations of such Work. Such Work shall be installed without additional cost to the Owner to clear all obstructions, permit proper clearances for the Work of other trades, and present an orderly appearance where exposed. Prior to beginning such Work, the Contractor shall prepare coordination drawings showing the exact alignment, physical location and configuration of the Mechanical, Electrical and Fire Protection installations and demonstrating to the Contractor's satisfaction that the installations will comply with the preceding sentence. A copy of the drawings shall be submitted to the Architect, and the Contractor shall revise and resubmit the drawings if so directed by the Architect.

§ 1.2.9 Exact locations of fixtures and outlets shall be obtained from the Architect as provided in subparagraph 3.2.5 before the Work is roughed in; Work installed without such information from the Architect shall be relocated at the Contractor's expense.

§ 1.2.10 Test boring or soil test information included with the Contract Documents or otherwise made available to the Contractor was obtained by the Owner for use by the Architects in the design of the Project or Work. The Owner does not hold out such information to the Contractor as a completely accurate indication of subsurface conditions, and no claim for extra cost or extension of time resulting from a reliance by the Contractor on such information shall be allowed except as provided in subparagraph 3.7.4.

§ 1.2.11 Where the Work is to fit with existing conditions or work to be performed by others, the Contractor shall fully and completely join the Work with such conditions or work, unless otherwise specified. Owner provided drawings showing existing conditions or construction are based on available documents and are not guaranteed to show actual existing conditions.

1.5.1 Delete 1.5.1 and replace as follows:

§ 1.5.1 All Drawings, Specifications and copies thereof furnished by the Owner are and shall remain the Owner's property. They are to be used only with respect to this Project and are not to be used on any other project without the prior written consent of the Owner. With the exception of one contract set for each party to the Contract, such documents are to be returned or suitably accounted for to the Owner at the completion of the Work. Submission or distribution to meet official regulatory requirements or for other purposes in connection with the Project is not to be construed as publication in derogation of any reserved rights.

ARTICLE 2 OWNER

2.1.2 Delete sub-section 2.1.2.

2.2.1 Delete the last three sentences.

2.2.3 In the first sentence insert “available” after “shall furnish”.

Delete the last sentence and replace as follows:

> The Owner makes no warranty as to the accuracy or completeness of such information, and the Contractor shall exercise proper precautions relating to the safe performance of the Work.

2.2.4 Delete the last sentence.

2.2.5 Add to the end of the sub-section as follows:

> All additional copies will be furnished upon request at the cost of reproduction.

2.3 Delete from the last sentence “, except to the extent required by Section 6.1.3” and add as follows:

> The Contractor shall resume the Work after such stoppage promptly upon written notice to do so from the Owner. The Contractor shall remain responsible for maintaining the progress of the Work and shall not be entitled to any increase in the Contract Sum or Contract Time. The Contractor shall be responsible for all costs incurred by the Owner attributable to such an order to stop the Work.

2.4 In the second sentence:

> Delete “Change Order” and replace with “Construction Change Directive”.
>
> Insert “and Owner’s Project Manager’s” after “for the Architect’s”.

Delete the third sentence.

Add to the end of the section as follows:

> The rights of the Owner hereunder are in addition to any other rights set forth in the Contract Documents or available at law or in equity.

ARTICLE 3 CONTRACTOR

3.2.1 Delete “generally” after “the site, become”.

Add to the end of the sub-section as follows:

> The Contractor shall not be entitled to any change in the Contract Time or Contract Sum on account of its failure, or that of any Subcontractor, to comply with the foregoing requirements.

3.2.2 Delete the beginning of the second sentence as follows:

> These obligations are for the purpose of facilitating coordination and construction by the Contractor and are not for the purpose of discovering errors, omissions, or inconsistencies in the Contract Documents; however,

Delete the last sentence and replace as follows:

> If the Contractor performs any construction activity that it knows or should know involves a recognized error, inconsistency or omission in the Contract Documents without such notice to the Architect, the Contractor shall assume appropriate responsibility for such performance and shall bear responsibility for the costs of any required correction.

3.2.3 Delete “not” after “Contractor is”.

Delete “, but” after “public authorities” and create new sentence beginning with “The Contractor shall promptly”.

3.2.4 Delete “claims” after “the Contractor shall make” and insert “a claim”.

Delete the last sentence.

3.2.5 Add new sub-section 3.2.5 as follows:

> § 3.2.5 Any claim by the Contractor or Subcontractors that, in submitting their respective bids, they did not include all items as shown in the Contract Documents will be given no consideration for an adjustment of any kind. If any item is specified in a Section which would not normally furnish this item it shall be the responsibility of the Contractor to coordinate the situation with the Subcontractor, and if the item under consideration is not to be provided by the Subcontractor it shall be the responsibility of the Contractor to provide the work in question, without any additional cost to the Owner.

3.3.1 Add to the end of the first sentence as follows:

which shall not be less than such state of skill and attention generally rendered by the contracting profession for projects similar to the Project in scope, difficulty and location. The Contractor shall adequately staff the Project to properly and thoroughly manage, schedule and supervise all construction activities.

Delete the last sentence.

3.3.2 Add the last sentence as follows:

This obligation shall also extend to the presence on the Site of suppliers of materials or equipment, their employees, contractors, and agents engaged in the Work.

3.4.3 Add to the end of the second sentence as follows:

, and the Contractor shall ensure that all workers to be employed on the Project have successfully completed a course in construction safety and health approved by the United States Occupational Safety and Health Administration (OSHA) of at least 10 hours. The Contractor shall be responsible for maintaining all safety precautions at and around the Project site. On the Owner's request, the Contractor shall permanently remove from the Project site any employee of the Contractor or any Subcontractor who fails to comply with the requirements of the Contract Documents or whose presence or behavior is deemed by the Owner to be adverse to the success of the Project or the Owner's interests.

3.5 Add to the end of the first sentence as follows:

and, promptly after written notification of non-conformance, shall be repaired or replaced by the Contractor with Work conforming to such requirements.

Delete the second to last sentence.

3.5.2 Add new sub-sections 3.5.2 to 3.5.8 as follows:
-3.5.8

§ 3.5.2 The Contractor shall be responsible for determining that all materials furnished for the Work meet all requirements of the Contract Documents. The Architect may require the Contractor to produce reasonable evidence that a material meets such requirements, such as certified reports of past tests by qualified testing laboratories, reports of studies by qualified experts, or other evidence which, in the opinion of the Architect, would lead to a reasonable certainty that any material used, or proposed to be used, in the Work meets the requirements of the Contract Documents. All such data shall be furnished at the Contractor's expense.

This provision shall not require the Contractor to pay for periodic testing of different batches of the same material, unless such testing is specifically required by the Contract Documents to be performed at the Contractor's expense.

§ 3.5.3 If the Contractor proposes to use a material which, while suitable for the intended use, deviates in any way from the detailed requirements of the Contract Documents, the Contractor shall inform the Architect in writing of the nature of such deviations at the time the material is submitted for approval and request approval of the deviation.
The Architect shall judge the design and appearance of proposed substitutes, an may refuse to approve any substitute which, in the Architect’s opinion, would be out of character or otherwise inconsistent with the character or quality of design of the Project.

§ 3.5.4 In informing the Architect of deviations or substitutions, the Contractor shall provide, upon request, evidence leading to a reasonable certainty that the proposed substitution or deviation will provide a quality of result at least equal to that otherwise attainable in accordance with the Contract Documents. If, in the opinion of the Architect, the evidence presented by the Contractor does not provide a sufficient basis for such reasonable certainty, the Architect may reject such substitution or deviation without further investigation.

§ 3.5.5 Any additional cost, or any loss or damage arising from the substitution of any material or any method for those originally specified shall be borne by the Contractor, notwithstanding approval or acceptance of such substitution by the Owner or the Architect, unless such substitution was made at the written request or direction of the Owner or the Architect.

§ 3.5.6 The warranty provided in this paragraph 3.5 shall be in addition to and not in limitation of any other warranty required by the Contract Documents or otherwise prescribed by law.

§ 3.5.7 The Contractor shall procure and deliver to the Architect, no later than the date claimed by the Contractor as the date of Substantial Completion, all special warranties required by the Contract Documents. Delivery by the Contractor shall constitute the Contractor's guarantee to the Owner that the warranty will be performed in accordance with its terms and conditions.

§3.5.8 The Contractor shall guarantee all Work for a period of one year after Date of Substantial Completion, or by the terms of any special guarantee required by the Contract Documents. The Contractor shall,

upon written notice from the Owner, promptly correct defective Work or Work not in accordance with the Contract Documents.

3.6.1 Add new sub-section 3.6.1 as follows:

§ 3.6.1 The project is exempt from the Massachusetts Sales Tax to the extent permitted by G.L. c.64H, §6(f). The exemption number will be provided by the Awarding Authority to the Contractor.

3.7.2 Add to the end of the sub-section as follows:

If any of the Work is required to be inspected or approved by any public authority, the Contractor shall cause such inspection or approval to be performed and shall comply with any instructions or corrections ordered by the public authority.

3.7.3 Delete “knowing it” after “performs Work” and replace with “it knows or should know”.

3.7.4 Delete sub-section 3.7.4 and replace as follows:

§ 3.7.4 Concealed or Unknown Conditions. Claims for concealed or unknown conditions shall be governed by Chapter 30, Section 39N of the General Laws of the Commonwealth of Massachusetts, as amended.

3.7.5 Delete second and last sentences.

3.8 Delete section 3.8 in its entirety.

3.9.1 In the first sentence:

Insert “, in accordance with the Contract Documents,” after “shall employ”.

Insert “at all times” after “the Project site”.

3.9.4 Add new sub-sections 3.9.4 and 3.9.5 as follows:
-3.9.5

§ 3.9.4 The Contractor shall coordinate and supervise the Work performed by Subcontractors to the end that the Work is carried out without conflict between trades and so that no trade, at any time, causes delay to the general progress of the Work. The Contractor and all Subcontractors shall at all times afford each trade, any separate contractor, or the Owner, every reasonable opportunity for the installation of Work and the storage of materials.

§ 3.9.5 The Contractor shall arrange for and attend job meetings with the Architect and such other persons as the Architect may from time to time wish to have present. The Contractor shall be represented by a principal, project manager, general superintendent or other authorized main office representative, as well as by the Contractor's own superintendent. An authorized representative of any Subcontractor or Sub-subcontractor shall attend such meetings if the representative's presence is requested by the Architect. Such representatives shall be empowered to make binding commitments on all matters to be discussed at such meetings, including costs, payments, change orders, time schedules and manpower. Any notices required under the Contract may be served on such representatives.

3.10.1 In the first sentence delete “promptly” after “The Contractor” and replace with “within twenty (20) days”.

In the second sentence, insert “or as requested by the Architect” after “conditions of the Work and Project”.

Add to the end of the sub-section as follows:

The construction schedule shall be in such form and contain such information as the Architect and Owner require. The construction schedule shall be resource loaded for the Contractor and all subcontractors, with each resource identified by name, description, unit of measure, and calendar assignment. For each class of work included in the Contractor’s schedule of values, the construction schedule shall show the percentage of completion to be obtained and the total dollar value of the work to be completed as of the first of each month until Substantial Completion. All calculations shall be on the basis of work in place, but not including the value of materials delivered but not in place.

3.10.3 Add to the end of the sub-section as follows:

The Contractor’s compliance with the construction schedule is a material obligation of the Contract.

3.10.4 Add new sub-sections 3.10.4, 3.10.5, and 3.10.6 as follows:
-3.10.6

§ 3.10.4 The Contractor shall monitor the progress of the Work for conformance with the requirements of the construction schedule and shall promptly advise the Owner of any delays or potential delays. The construction schedule shall be updated every month (or more frequently if requested by the Owner) to reflect actual conditions (such updates are sometimes referred to in these General Conditions as "progress reports"). In the event any progress report indicates delays in achievement of any milestone date set forth in such schedule, the Contractor shall propose in

written form an affirmative plan (the "Recovery Schedule") to correct the delay, including overtime and/or additional labor, if necessary, which Recovery Schedule shall indicate the date by which the progress of the Work will comply with the construction schedule, and shall be subject to the approval of the Owner and the Architect. In no event shall any progress report or Recovery Schedule constitute an adjustment in the construction schedule, Contract Time or any milestone date unless any such adjustment is agreed to by the Owner and authorized pursuant to a Change Order.

§ 3.10.5 In the event (i) that the performance of the Work, as of a milestone date, has not progressed or reached the level of completion required by the construction schedule, and (ii) the progress of the Work is not brought back into compliance with the construction schedule on the date proposed by the Recovery Schedule, or the Contractor otherwise fails to comply with the Recovery Schedule, the Owner shall have the right to order the Contractor to take corrective measures to expedite the progress of the Work, including, without limitation, (1) supplying additional manpower, equipment, and facilities, (2) working additional shifts or overtime, (3) working additional days, and (4) other similar measures (hereinafter referred to collectively as "Corrective Measures"). Such Corrective Measures shall continue until the progress of the Work complies with the stage of completion required by the Contract Documents.

§ 3.10.6 The Contractor shall not be entitled to an adjustment in the Contract Sum in connection with Corrective Measures required by the Owner under or pursuant to Section 3.10.5. The Owner may exercise the rights furnished the Owner under or pursuant to Section 3.10.5 as frequently as reasonably necessary to ensure that the Contractor's performance of the Work complies with the milestone dates set forth in the construction schedule.

3.12.6 Add to the end of the sub-section as follows:

By approving and submitting Shop Drawings, Product Data, Samples, and similar submittals the Contractor thereby represents that the Contractor has determined and verified all dimensions, quantities, field dimensions, relations to existing work, coordination with work to be installed later, coordination with information on previously accepted Shop Drawings, Product Data, Samples, or similar submittals and verification of compliance with all the requirements of the Contract Documents. The accuracy of all such information is the responsibility of the Contractor. In reviewing Shop Drawings, Product Data, Samples, and similar submittals the Architect shall be entitled to rely upon the Contractor's representation that such information is correct and accurate.

3.12.10 Add to the end of the last sentence as follows:

, except as provided in Section 3.2.

3.12.11 Add new subsection 3.12.11 as follows:

§ 3.12.11 When professional certification of materials, systems or equipment is required by the Contract Documents, the Owner shall be entitled to rely upon such certifications, and neither the Owner nor the Architect shall be expected to make an independent examination with respect to the performance of such materials, systems or equipment.

3.13 Add to the end of the section as follows:

The right of possession of the premises and the improvements made thereon by the Contractor shall remain at all times with the Owner. The Contractor's right to entry and use thereof arises solely from the permission granted by the Owner under the Contract Documents. The Owner shall not be liable to the Contractor, the Subcontractors, their employees, or anyone else with respect to the conditions of the premises, except only for a condition caused directly and solely by the negligence of the Owner.

3.15.1 Add “site” to the end of the second sentence.

3.15.2 Add to the end of the sentence as follows:

, and may deduct all costs thereof from any payment due the Contractor.

3.16 Insert “, Owner’s representatives” after “provide the Owner”.

3.18.1 Delete the first sentence and replace as follows:

To the fullest extent permitted by law the Contractor shall indemnify and hold harmless the Owner, Architect, Architect’s consultants, and agents and employees of any of them from and against claims, damages, losses and expenses, including but not limited to attorneys’ fees, arising out of or resulting from performance of the Work, including claims, damage, loss or expense attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property, including the Work, caused in whole or in part by the negligent or wrongful acts or omissions of the Contractor, a Subcontractor, anyone directly or indirectly employed by them or anyone for whose acts they may be liable, regardless of whether or not such claim, damage, loss or expense is caused in part by a party indemnified hereunder. Such obligation shall not be construed to negate,

abridge, or reduce other rights or obligations, including those of indemnity, which would otherwise exist as to a party or person described in this section.

ARTICLE 4 ARCHITECT

4.1.2 In the first sentence delete ", Contractor" after "consent of the Owner".

In the second sentence insert "of the Owner" after "Consent".

4.1.3 Delete sub-section 4.1.3.

4.2.3 In the first sentence delete "reasonably" after "will keep the Owner".

4.2.10 Delete sub-section 4.2.10.

4.2.11 Add to the end of the sub-section as follows:

The parties agree that the Architect's duties under this subparagraph shall be governed by Chapter 30, Section 39P of the General Laws of the Commonwealth of Massachusetts, as amended.

4.2.12 Delete the second sentence.

ARTICLE 5 SUBCONTRACTORS

5.2.1 Delete the last sentence.

5.2.2 In the second sentence insert "and legally permissible" after "has made reasonable".

5.2.3 Delete the last two sentences and replace as follows:

No increase in the Contract Sum or Contract Time shall be allowed for such change.

5.2.4 Add to the end of the sub-section as follows:

The applicable provisions of Chapter 149, Section 44F of the General Laws of the Commonwealth of Massachusetts shall apply to filed sub-bid subcontractors, including without limitation the obligation relative to subcontractor performance and payment bonds.

5.4.1 In sub-heading .1 delete "Section 14.2" and replace with "Article 14".

Add new sub-heading .3 as follows:

.3 The Owner may further assign the subcontract to a successor contractor or other entity.

Delete last sentence of sub-section.

5.4.2 Delete sub-sections 5.4.2 and 5.4.3.
-5.4.3

ARTICLE 6 CONSTRUCTION BY OWNER OR SEPARATE CONTRACTORS

6.1.1 At the end of the first sentence delete "including those portions related to insurance and waiver of subrogation".

In the second sentence delete "Claim" after "shall make such" and replace with "claim".

6.1.4 Delete sub-section 6.1.4 and replace as follows:

§ 6.1.4 The Owner reserves the right to enter any part of the Project site at any time to inspect the Work or to perform other work with its own forces or separate contractors, or to address any emergency situation. Such access is not to be construed to mean partial occupancy by the Owner and no claim for increase in the Contract Time or Sum will be considered unless such Owner's contractors have delayed or damaged the Contractor's Work. The Contractor shall permit the Owner to place and install as much furniture, equipment and other material during the progress of the Work as is possible before completion of the various parts of the Work and agrees that such placing and installation of equipment shall not in any way evidence the completion or acceptance of the Work or any portion of it.

6.2.3 Delete the last sentence.

6.2.5 Delete sub-section 6.2.5.

ARTICLE 7 CHANGES IN THE WORK

7.2.3 Add new sub-section 7.2.3 as follows:

§ 7.2.3 Upon request of the Owner or the Architect, the Contractor shall without cost to the Owner submit to the Architect, in such form as the Architect may require, an accurate written estimate of the cost of any proposed extra Work or change. The estimate shall indicate the quantity and unit cost of each item of material, and the number of hours of work and hourly rate for each class of labor, as well as a description and the

amounts of all other costs chargeable under the terms of this Article. Unit labor costs for the installation of each item of material shall be shown if required by the Architect. The Contractor shall promptly revise and resubmit each estimate if the Architect determines that it is not in compliance with the requirements of this Article, or that it contains errors of fact or mathematical errors. If required by the Architect, in order to establish the exact cost of new Work added or of previously required Work omitted, the Contractor shall obtain and furnish to the Architect bona fide proposals from recognized suppliers for furnishing any material included in such Work. Such estimates shall be furnished promptly so as to occasion no delay in the Work, and shall be furnished at the Contractor's expense. The Contractor shall state in the estimate any extension of time required for the completion of the Work if the change or extra work is ordered.

7.3.3 Delete the first sentence of the sub-section and replace as follows:

If the Construction Change Directive provides for an adjustment to the Contract Sum, and if the Contract Documents include a unit price for the work that is the subject of such directive, such unit price shall be the basis of the adjustment to the Contract Sum, unless the Owner, in its sole discretion, chooses another method. If, however, the Contract Documents do not include a unit price for such work, the adjustment shall be based on one of the following methods, as selected by the Owner:

In sub-heading .2 delete “stated in the Contract Documents or” after “Unit prices”.

7.3.4 Delete sub-section 7.3.4 and replace as follows:

§ 7.3.4 If unit prices are stated in the Contract Documents or subsequently agreed upon, and if quantities originally contemplated are materially changed in a proposed Change Order or Construction Change Directive so that, in the opinion of the Architect, application of such unit prices to quantities of Work proposed will cause substantial inequity to the Owner, the applicable unit prices shall be equitably adjusted.

7.3.5 In the first sentence add after “the Work involved and” as follows:

, within five (5) calendar days from receipt of the Construction Change Directive,”

Insert “by written notice” after “advise the Architect”.

Add to the end of the sub-section as follows:

Failure to so advise the Architect within such 5-day period (1) shall be interpreted as Contractor's agreement with the proposed method of adjustment; (2) shall constitute an irrevocable waiver of any right of the Contractor to submit a claim on account of the method of adjustment; and (3) shall cause the Construction Change Directive to be deemed and constitute a Change Order.

7.3.6 In the second sentence delete "recorded as" after "immediately shall be" and replace with "deemed and shall constitute".

7.3.7 Delete first sentence and replace as follows:

If the proposed method of adjustment in the Contract Sum is based on unit prices that are stated in the Contract Documents, such unit prices shall be the basis of any adjustment to the Contract Sum, unless the Owner has chosen another method pursuant to subparagraph 7.3.3. If the proposed method of adjustment is not based on such unit prices and the Contractor objects to the proposed method of adjustment, the Contractor must notify the Architect of such objection in writing within five (5) calendar days from Contractor's receipt of the Construction Change Directive. Failure to so object will irrevocably waive any such objections and claims on account of such method of adjustment, and the Construction Change Directive shall be deemed and shall constitute a Change Order. If the Contractor does so object, the adjustment to the Contract Sum shall be determined by the Architect on the basis of reasonable expenditures and savings of those performing the Work attributable to the change, including, in case of an increase in the Contract Sum, a reasonable allowance for overhead and profit.

In sub-heading .4 insert "and" after "and insurance," and delete ", and sales, use or similar taxes related to the Work" after "permit fees".

Delete sub-heading .5 and replace as follows:

.5 A reasonable allowance for overhead and profit that shall not exceed an amount equal to 15% of the total value of the Work.

7.3.9 Delete the end of the first sentence starting after "Directive to the Owner," and replace as follows:

amounts for such changes in the Work shall not be included in Applications for Payment. Such amounts shall only be included in an Application for Payment after the adjustment for the Construction Change Directive has been included in a Change Order signed by the Owner and the Contractor.

ARTICLE 8 TIME

8.2.2 In the first sentence delete ", except by agreement or instruction of the Owner in writing, prematurely".

8.2.4 Add new sub-sections 8.2.4 and 8.2.5 as follows:
-8.2.5

§ 8.2.4 Unless specifically required by law, no payment under this Contract shall be due until the construction schedule, required by Section 3.10, and conforming to the requirements of the General Requirements has been accepted by the Architect.

§ 8.2.5 If the Architect in reviewing any Application for Payment determines that the amount of completed Work in place as certified by the Architect is less than 90% of the Work in place required by the Contractor's construction schedule or schedule of values provided for in Section 9.2, or that there have been delays to critical paths and the Contract completion date will not be met, or that, in the Owner's sole discretion, there is reasonable concern that the Work will not be Substantially Complete by the date required in the Contract Documents, the Contractor shall be required to submit a recovery schedule with a written description of the steps the Contractor intends to take to put the Project back on schedule. At the Owner's option, the Contractor shall take some or all of the following actions at no additional cost to the Owner:

.1 Increase the number of workers on the site, in such quantities and trades as will substantially eliminate the backlog of work;
.2 Increase the number of working hours per shift, shifts per day, working days per week, amount of construction equipment, or any combination of the foregoing, sufficiently to substantially eliminate backlog of work; or
.3 Reschedule activities so that the completion dates initially scheduled will be met.

8.3.1 Insert "(except weather)" after "casualties or other causes".

Delete "pending mediation and arbitration" after "delay authorized by Owner".

Add to the end of the sub-section as follows:

, and this shall be the Contractor's sole remedy for such delay. Under no circumstances will the Contractor be entitled to an increase in the Contract Sum, or to any other damages, on account of or in connection with any delay, regardless of the cause of such delay, and Contractor agrees not to make any claim for such damages, including, but not limited, claims for damages on account of having to perform out-of-sequence work, claims

for damages on account of loss of production, and claims for damages on account of hindrances or interference with the work.

8.3.3 Delete sub-section 8.3.3.

8.3.4 Add new sections 8.3.4 and 8.3.5 as follows:
-8.3.5

§ 8.3.4 No extension of time shall be granted because of seasonal or abnormal variations in temperature, humidity or precipitation, which conditions shall be wholly at the risk of the Contractor, whether occurring within the time originally scheduled for completion or within the period of any extension granted. There shall be no increase in the Contract Sum on account of any additional costs of operations or conditions resulting therefrom.

§ 8.3.5 The Contractor hereby agrees that the Contractor shall have no claim for damages of any kind against the Owner or the Architect on account of any delay in the commencement of the Work and/or any hindrance, delay or suspension of any portion of the Work, whether such delay is caused by the Owner, the Architect, or otherwise, except as and to the extent expressly provided in G.L. c. 30, §39N. The Contractor acknowledges that the Contractor's sole remedy for any such delay and/or suspension will be an extension of time as provided in this Article.

8.4 Add new section 8.4 as follows:

§ 8.4 LIQUIDATED DAMAGES

§ 8.4.1 It is expressly understood and agreed, by and between the Contractor and Owner, that the time for the completion of the Work described herein is a reasonable time for the completion of same, taking into consideration the average climatic range and usual industrial and/or residential conditions prevailing in this locality. If the said Contractor shall neglect, fail or refuse to complete the Work within the times herein specified, or any proper extension thereof granted by the Owner, then the Contractor does hereby agree, as a part consideration for the awarding of this Contract, to pay to the Owner $_____, not as a penalty but as liquidated damages for such breach of contract, for each and every calendar day that the Contractor shall be in default after the time stipulated for completing the Work. The said amount is fixed and agreed upon by and between the Contractor and the Owner because of the impracticability and difficulty of fixing and ascertaining the actual damages the Owner would in such event sustain, and said amount is agreed to be the amount of damages which the Owner would sustain and said amount shall be deducted by the Owner from periodic payments.

ARTICLE 9 SCHEDULE OF VALUES

9.2 Add to the end of the section as follows:

, and shall be revised if later found by the Architect to be inaccurate. In addition, the Contractor shall submit to the Architect, at least 14 days before the first Application for Payment, a Cash Flow Schedule that shows the percentage completion to be obtained and the total dollar value of Work to be completed as of the first of each month until Substantial Completion. All calculations in the Cash Flow Schedule shall be on the basis of Work in place and shall exclude the value of materials delivered but not in place.

9.2.1 Add new sub-section 9.2.1 as follows:

§ 9.2.1 The Cash Flow Schedule shall be based on an orderly progression of the Work allowing adequate time for each operation (including adequate time for submission and review of submittals) and leading to a reasonable certainty of Substantial Completion by the date established in the Agreement. The Cash Flow Schedule will be reviewed by the Architect for compliance with the requirements of the Contract Documents. Unless specifically required by law, no payment under this Contract shall be due until the Cash Flow Schedule has been reviewed and approved by the Architect. The Architect's review of the Cash Flow Schedule shall not impose any duty on the Architect or the Owner with respect to the timing, planning, scheduling or execution of the Work. In particular if the Contractor proposes a Cash Flow Schedule indicating a date of Substantial Completion which is earlier than the Contract Time the Contractor shall not be entitled to additional payment or compensation of any kind if for any reason the full Contract Time is required to achieve Substantial Completion of the Work.

9.3.1.1 Delete sub-section 9.3.1.1.

9.3.2 Add to the end of the sub-section as follows:

The Owner may deduct the amount of such costs from payments due the Contractor.

9.4.1 Insert at the beginning of the first sentence as follows:

Subject to the Contractor's compliance with Section 9.3 and the provisions of Section 9.6,

9.5.1 Add new sub-headings .8, .9, .10, .11, and .12 as follows:

.8 failure of the Contractor or mechanical or electrical trade subcontractors to comply with requirements of the General Requirements for maintaining record drawings. The Contractor shall check record drawings each month. Written confirmation that the record drawings are current will be required by the Architect before approval of the Contractor's monthly payment requisition;
.9 failure of the Contractor to provide required warranties under Section 9.3, claims for direct payment, or reasonable evidence indicating probable filing of such claims;
.10 costs incurred by the Owner under Section 10.2.5;
.11 failure of the Contractor to submit prerequisite documentation required by the General Requirements; or
.12 liquidated damages due the Owner pursuant to Section 8.4.

9.5.3 Delete sub-section 9.5.3.

9.6.4 Delete “If the Contractor fails to furnish such evidence within seven days,” from the beginning of the second sentence.

9.6.5 Delete sub-section 9.6.5.

9.6.7 Delete sub-section 9.6.7.

9.6.8 Add new sub-section 9.6.8 as follows:

§ 9.6.8 Notwithstanding the provisions of Section 9.6 all progress payments shall be made in accordance with Chapter 30, Sections 39F, 39G and 39K (as appropriate) of the General Laws of the Commonwealth of Massachusetts, as amended.

9.7 Delete section 9.7.

9.8.1 Add to the end of the sub-section as follows:

In addition, Substantial Completion for the entire Project shall be achieved only when: (1) the Owner has beneficial occupancy and use of the entire Project for all its intended uses; (2) all Project systems included in the Work are operational and acceptable to the Owner; (3) all governmental inspections for the Project have been successfully completed, all governmental approvals and related paperwork have been delivered to the Owner, and final and unconditional certificates of occupancy for the entire Project have been delivered to the Owner, (4) the only remaining Work to be performed is minor in nature and the remaining Work may reasonably be performed without having a material adverse effect on or materially interfering with the Owner’s occupancy and use of the Project and (5) all

prerequisites to Substantial Completion defined in the Contract Documents have been completed.

9.8.2 Add to the end of the first sentence as follows:

together with the estimated value of completing or correcting such items (the "Punchlist") and (2) the permits and certificates referenced in Section 13.5. The Architect shall have the right to modify and supplement the Punchlist, including the estimated value of completion or correction.

9.8.5 Delete sub-section 9.8.5 and replace as follows:

§ 9.8.5 The Certificate of Substantial Completion shall be submitted to the Owner and Contractor by the Architect. The certificate shall state the date of substantial completion, shall state any consequent responsibilities of the Contractor and the Owner in accordance with the Contract Documents. The Contractor shall complete and correct any incomplete and defective work within forty-five (45) calendar days from the date of Substantial Completion

9.8.6 Add new sub-section 9.8.6 as follows:

§ 9.8.6 Services provided by the Architect to conduct more than two (2) inspections of completed Work and any inspections beyond sixty (60) days after the date of substantial completion of any portion of the Work as stated in the Agreement shall be paid by the Contractor to the Owner. The Owner may deduct the cost of such services and inspections from payments due the Contractor.

9.9.1 Delete the end of the first sentence starting after "Work at any stage".

Delete the second sentence and replace as follows:

Such partial occupancy or use may commence whether or not the portion is substantially complete, provided the Owner has accepted in writing the responsibilities assigned to it and the Contractor for payments, retainage, if any, security, maintenance, heat, utilities, damage to the Work and insurance.

Delete the second to last sentence.

9.10.1 Add to the end of the sub-section as follows:

By Final Completion, the Contractor shall have completed its performance of all Punchlist items, completed all balancing of mechanical and other applicable systems and all seasonal system adjustments that are reasonably

necessary to proper functioning of the completed Project, delivered to the Owner all operations and maintenance manuals and completed related training for such manuals, and delivered to the Owner all required warranties and guarantees.

9.10.3 Delete sub-sections 9.10.3 and 9.10.4.
-9.10.4

9.10.5 Insert “for payment for Work performed and of all other claims of which the payee knew or should have known at the time of final payment,” after “claims that payee”

9.10.6 Add new sub-section 9.10.6 as follows:

§ 9.10.6 Notwithstanding anything in the Contract Documents to the contrary, final payment shall be made in accordance with the requirements of G.L.c.30, §39K (building projects) or §39G (public works projects), as amended.

ARTICLE 10 PROTECTION OF PERSONS AND PROPERTY

10.2.1 Add new sub-heading .4 as follows:

.4 work or property of the Owner, its tenants, or other parties at or near the Project site with the Owner's permission.

10.2.5 At the beginning and end of the first sentence:

Delete “and” after “10.2.1.2”.

Insert “and 10.2.1.4” after “10.2.1.3”.

Delete the remainder of the first sentence as follows:

, except damage or loss attributable to acts or omissions of the Owner or Architect or anyone directly or indirectly employed by either of them, or by anyone for whose acts either of them may be liable, and not attributable to the fault or negligence of the Contractor.

Add to the end of the sub-section as follows:

Where the damage or loss presents an immediate danger to the public, the Owner, in its sole discretion and at the Contractor’s expense, may promptly remedy such damage or loss without prior notice to the Contractor.

10.2.9 Add new sub-sections 10.2.9, 10.2.10, 10.2.11, 10.2.12, and 10.2.13 as follows: -10.2.13

§ 10.2.9 The Contractor shall provide and maintain in good operating condition suitable and adequate fire protection equipment and services, and shall comply with all reasonable recommendations regarding fire protection made by the representatives of the fire insurance company carrying insurance on the Work or by the local fire chief or fire marshal. The area within the site limits shall be kept orderly and clean, and all combustible rubbish shall be promptly removed from the site.

§ 10.2.10 The Contractor shall at all times protect excavations, trenches, buildings and materials from rain water, groundwater, backup or leakage of sewers, drains and other piping, and from water of any other origin and shall remove promptly any accumulation of water. The Contractor shall provide and operate all pumps, piping and other equipment necessary to this end.

§ 10.2.11 The Contractor shall remove snow and ice which might result in damage or delay.

§ 10.2.12 During the progress of the Work and at all times prior to the date of Substantial Completion or occupancy of the Work by the Owner, whichever is earlier, the Contractor shall provide temporary heat, ventilation, and enclosure, adequate to permit the Work to proceed in a timely fashion, and to prevent damage to completed Work or Work in progress, or to materials stored on the premises. The use of the permanent heating and/or ventilation systems for temporary heat and/or ventilation shall be subject to the prior written approval of the Owner and Architect.

§ 10.2.13 [G.L. c.149, §44F(1)] The Contractor shall install weather protection and furnish adequate heat in the protected area from November 1 to March 31.

10.3.1 Delete the second sentence and replace as follows:

The Contractor shall not cause or permit any introduction onto, under, or near the Owner's property of any hazardous materials or substances as defined by any applicable law, and shall not cause of permit any release, discharge, transportation, storage, or disposal of such materials or substances onto, under, or near the Owner's property or areas near the Owner's property. If the Contractor encounters or recognizes on the site any material known or reasonably believed to be hazardous, including but not limited to asbestos or polychlorinated biphenyl (PCB), the Contractor shall immediately stop Work in the area affected and report the condition to the Owner and Architect in writing. The Contractor and the Owner shall cooperate in implementing measures to remove or contain said

material and the Contractor shall comply with all directions of the Architect in the implementation of such removal or containment.

10.3.2 Delete sub-sections 10.3.2, 10.3.3, and 10.3.4.

10.3.5 Delete the remainder of the sentence starting after "obligations under" and replace as follows:

Article 10 or for any violation of applicable law related to the Contractor's noncompliance with the provisions of this Article 10.

10.3.6 Delete sub-section 10.3.6.

10.3.7 Add new sub-section 10.3.7 as follows:

§ 10.3.7 The parties anticipate that certain hazardous substances and/or materials may be discovered at the site. When such conditions are set forth in the Contract Documents, the Contractor acknowledges that such conditions have been considered in establishing the Contract Time and Contract Sum. No extension of the Contract Time or increase in the Contract Sum shall be claimed or allowed with respect to any hazardous substances or materials located at the site which were disclosed in the Contract Documents. The Contractor shall strictly comply with all laws, regulations, rules, orders, ordinances and the like related to the excavation, storage, removal and disposal of any such hazardous substances or materials.

ARTICLE 11 INSURANCE AND BONDS

11.1.2 Delete sub-section 11.1.2 and replace as follows:

§ 11.1.2 The insurance required by Section 11.1.1 shall include all major divisions of coverage, and shall be on a comprehensive general basis including Premises and Operations (including X-C-U), Owner's and Contractor's Protective, Products and Completed Operations, and Owned, Non-owned, and Hired Motor Vehicles. Such insurance shall be written for not less than any limits of liability required by law or those set forth in the Contract Documents, whichever is greater.

All insurance shall be written on an occurrence basis, unless the Owner approves in writing coverage on a claims-made basis. Coverages, whether written on an occurrence or claims-made basis, shall be maintained without interruption from date of commencement of the Work until date of final payment and any further period during which coverage is required to be maintained after final payment by the Contract Documents. The Owner shall be named an Additional Insured on all policies.

Coverage for such liability insurance shall be provided by a company or companies reasonably acceptable to the Owner and authorized to do business in Massachusetts. Contractor shall furnish to Owner written confirmation as to the insurance carrier's most current financial ratings prior to commencing work.

11.1.3 Add to the end of the sub-section as follows:

These certificates shall set forth evidence of all coverage required by Sections 11.1.1 and 11.1.2. The Contractor shall furnish to the Owner copies of any endorsements that are subsequently issued amending limits of coverage.

11.1.3.1 Add new sub-sections 11.1.3.1 and 11.1.3.2 as follows:
-11.1.3.2

11.1.3.1 The Contractor shall be responsible for having acceptable insurance coverage provided by or on behalf of all Subcontractors, with such insurance to be similar to that required of the Contractor under the Agreement and these General Conditions. The Contractor shall not allow any Subcontractor to commence Work on the Project prior to the Contractor’s receipt of certificates of insurance that are acceptable in form and limits to the Owner; the Owner shall have no obligation to pay the Contractor for any Work performed by a Subcontractor who has not supplied acceptable insurance certificates prior to starting its Work. The Owner shall be named an additional insured on all such certificates.

11.1.3.2 All insurance policies shall contain provisions or endorsements necessary to assure coverage of claims by one insured against another. All required insurance policies are to be endorsed to state that the Contractor’s policies shall be primary to all other insurance available to the Owner and other specified additional insureds for liability arising out of or resulting from the Contractor’s operations under the Contract, whether such operations be by the Contractor or by a Subcontractor or by anyone directly or indirectly employed by any of them or by anyone for whose acts any of them may be liable.

11.1.4 Insert “the Owner’s Project Manager,” after “(1) the Owner,”.

11.1.5 Add new sub-section 11.1.5 as follows:

§ 11.1.5 In no case shall the limits of liability be less than the following:

1. Contractor's Liability Insurance

a. Workers’ Compensation:

1. State: Statutory

2. Employer Liability:

$100,000 Bodily Injury by Accident
$500,000 Bodily Injury by Disease - policy limit
$100,000 Bodily Injury by Disease - each

b. Comprehensive General Liability (including Premises-Operations; Independent Contractor's Protective; Products and Completed Operations; Broad Form Property Damage):

1. Bodily Injury and Property Damage (including coverage for XCU hazards):

$1,000,000 Each Occurrence
$3,000,000 Aggregate

2. Products and Completed Operations
.

$3,000,000 Each Occurrence
$3,000,000 Aggregate

3. Products and Completed Operations insurance shall be maintained for a minimum period of 2 years after final payment and Contractor shall continue to provide evidence of such coverage to Owner on an annual basis during the aforementioned.

4. Personal Injury, with Employment Exclusion deleted:
$1,000,000 All Limits

c. Comprehensive Automobile Liability (owned, non-owned, hired):

1. Bodily Injury and/or Property Damage, $1,000,000 combined single limit

d. Umbrella Liability Coverage
$2,000,000 All Limits

11.2 Delete section 11.2 and replace as follows:

§ 11.2 OWNER'S LIABILITY INSURANCE
The Contractor shall procure and pay for an Owner's policy of Owner's protective liability insurance insuring the Owner and its officers,

employees and agents against claims which may arise from operations under the Contract or relating thereto.

11.3.1 Delete sub-section 11.3.1 and replace as follows:

§ 11.3.1 The Owner will carry property insurance/builder's risk to cover the full value of the Project.

11.3.1.1 Delete sub-sections 11.3.1.1, 11.3.1.2, 11.3.1.3, 11.3.1.4, and 11.3.1.5. -11.3.1.5

11.3.2 Delete sub-sections 11.3.2, 11.3.3, 11.3.4, 11.3.5, 11.3.6, and 11.3.7. -11.3.7

11.3.8 Delete the first sentence.

11.3.9 Delete sub-sections 11.3.9 and 11.3.10. -11.3.10

11.3.11 Add new sub-section 11.3.11 as follows:

§ 11.3.11 The Owner shall have the power to adjust and settle with its insurers any loss for which it has obtained insurance.

Upon the occurrence of an insured loss, the Owner and the Contractor shall cooperate with each other and with each other's insurer in the submission of claims and related information and the distribution of any insurance proceeds. If after such a loss no other special agreement is made, replacement of damaged work shall be covered by an appropriate change order.

11.4.1 Delete "Owner shall have the right to require the".

Delete "to" after "Contractor" and replace with "shall".

Delete the end of the sentence starting after "obligations arising thereunder" and replace as follows:

, each in the amount of 100% of the Contract Price, and each by a surety company qualified to do business under the laws of the Commonwealth of Massachusetts and acceptable to the Owner. The attorney-in-fact who signs the bonds on behalf of the surety, must affix to each bond a certified and current copy of the power of attorney. The Performance and Payment Bonds shall be written in a form satisfactory to the Owner.

ARTICLE 12 UNCOVERING AND CORRECTION OF WORK

12.2.1 Add to the end of the sub-section as follows:

The Contractor shall bear the cost of any loss or damages to the Owner resulting from such failure or defect.

12.2.2.1 Delete the third sentence.

Add to the end of the sub-section as follows:

If the correction or repair of any of the Work is required to avoid impacts to the maintenance, operation or safety of any portion of the Project site or the Owner's property, the Owner reserves the right to undertake the repairs prior to notifying the Contractor or without waiting for the Contractor to respond, without waiving the Owner's rights under the warranties and the Owner's right to correct work under Section 2.4.

ARTICLE 13 MISCELLANEOUS PROVISIONS

13.1 Delete the end of the sentence following the words "by the law of the", and insert the words "Commonwealth of Massachusetts" at the end of the sentence as revised.

13.2.1 In the second sentence delete "Except as provided in Section 13.2.2".

13.2.2 Delete sub-section 13.2.2.

13.5.4 Delete sub-section 13.5.4 and replace as follows:

§ 13.5.4 The Contractor shall obtain and deliver promptly to the Architect any occupancy permit and any certificates of final inspection of any part of the Contractor's work and operating permits for any mechanical apparatus, such as elevators, escalators, boilers, air compressors, etc., which may be required by law to permit full use and occupancy of the premises by the Owner. Receipt of such permits or certificates by the Architect shall be a condition precedent to Substantial Completion of the Work.

13.7 Delete section 13.7.

13.7.1 Add new sub-section 13.7.1 as follows:

§ 13.7.1 It is expressly agreed that the obligations of the Contractor hereunder arise out of contractual duties, and that the failure of the Contractor to comply with the requirements of the Contract Documents shall constitute a breach of contract, not a tort, for the purpose of

applicable statutes of limitation and repose. Any cause of action which the Owner may have on account of such failure shall be deemed to accrue only when the Owner has obtained actual knowledge of such failure, not before.

13.8 Add new section 13.8 as follows:

§ 13.8 LIMITATION OF LIABILITY

§ 13.8.1 The Owner shall be liable, if ever, only to the extent of its interest in the Project; and no officer, director, partner, agent or employee of the Owner shall ever be personally or individually liable with respect to this Contract or the Work. Each Subcontract shall include the foregoing limitation, which shall be effective if the Owner ever succeeds to the Contractor's rights and obligations under a Subcontract.

13.9 Add new section 13.9 as follows:

§ 13.9 DEFENSE OF SUITS

§ 13.9.1 The Contractor shall be responsible for, shall defend and pay all costs, attorneys' fees and liabilities both direct and indirect as a result of suits arising out of this Contract.

§ 13.9.2 Neither final acceptance nor occupation of the premises by the Owner shall relieve the Contractor of responsibility for all claims for labor, materials, and equipment arising out of this Contract.

§ 13.9.3 The Contractor shall indemnify and hold harmless the Owner and the Architect and their agents and employees from and against all claims, damages, losses, and expenses including attorneys' fees arising out of or resulting from the performance of the work.

ACTICLE 14 TERMINATION OR SUSPENSION OF THE CONTRACT

14.1.1 Insert in the beginning of the first sentence as follows:

Provided that the Contractor is not in breach of any of its obligations under the Contract,

Delete sub-headings .1, .2, and .4.

Add to the end of sub-heading .3 as follows:

or Owner fails for 30 days to pay Contractor any sum finally determined to be due, whichever is later.

14.1.2 Delete sub-section 14.1.2.

14.1.3 Delete sub-section 14.1.3 and replace as follows:

> § 14.1.3 If one of the above reasons exists, the Contractor may, upon seven days written notice to the Owner and Architect and unless Owner or Architect do not remedy such suspension or failure within that time, terminate the Contract and recover from the Owner payment for Work properly executed and for all materials or equipment not incorporated in the Work, but delivered and suitably stored at the site. The payment for materials or equipment stored at the site shall be conditioned upon submission by the Contractor of bills of sale or such other evidence as is satisfactory to the Owner to establish the Owner's title to such material or equipment or otherwise protect the Owner's interest.
>
> In lieu of terminating the Contract as aforesaid, Contractor may, seven days after written notice to the Owner and Architect and unless Owner and Architect do not remedy such suspension or failure within that time, stop the Work until payment is made of all such amounts due Contractor. The provisions of this paragraph are not intended to preclude Contractor from submitting a Claim for an adjustment in Contract Sum or Contract Time or otherwise for expenses or damage directly attributable to Contractor's stopping the Work as permitted by this paragraph.

14.1.4 Delete sub-section 14.1.4.

14.2.1 Delete "repeatedly" from the beginning of sub-headings .1 and .3.

Insert new sub-headings .4 and .5 after sub-heading .3 as follows:

> .4 becomes the subject of a voluntary petition in bankruptcy or any voluntary proceeding related to insolvency, receivership, liquidation or comparable proceeding or any assignment for the benefit of creditors or becomes the subject of an involuntary petition in bankruptcy or any involuntary proceeding related to insolvency, receivership, liquidation or comparable proceeding or any assignment for the benefit of creditors.
>
> .5 submits three successive Applications for Payment, each of which indicate that the actual Work completed is less than 90 percent of the values estimated in the construction schedule (submitted by the Contractor pursuant to Section 3.10.1) to be completed by the respective dates.

14.2.2 In the first sentence delete ",upon certification by the Initial Decision Maker that sufficient cause exists to justify such action,".

Delete the second sentence of sub-heading .3.

14.2.4 In the first sentence:

Insert “all costs and losses incurred by the Owner on account of the Contractor’s failure to comply with the Contract Documents and” after “the Work, including”.

Insert “and Owner’s Project Manager’s” after “for the Architect’s”.

Delete the last sentence of the sub-section and replace as follows:

The Owner shall be entitled to hold all amounts due the Contractor at the date of termination until all of the Owner’s damages have been established, and to apply such amounts to such damages.

14.3.2 Insert “, subject to compliance with the conditions of Section 8.3.” at the end of the first sentence.

Delete the second sentence.

14.4.2 In sub-heading .3 delete “and” after “all existing contracts” and replace with “except for subcontracts, if any, that Owner elects to assume, terminate all”

14.4.3 Delete sub-section 14.4.3 and replace as follows:

§ 14.4.3 In the event that the Contract is terminated for the Owner’s convenience, the Contractor shall be reimbursed in accordance with the Contract Documents for all Work properly performed up to the termination date, and for all materials or equipment not incorporated in the Work, but delivered and suitably stored at the site. Payment for materials or equipment stored at the site shall be conditioned upon submission by the Contractor of bills of sale or such other evidence as is satisfactory to the Owner to establish the Owner's title to such material or equipment or otherwise protect the Owner's interest. The Contractor shall not be entitled to payment for overhead and profit on the Work not executed.

ARTICLE 15 CLAIMS AND DISPUTES

15.1.1 Delete sub-section 15.1.1 and replace as follows:

§ 15.1.1 DEFINITION
The word “Claim” shall mean a written demand by the Contractor for an increase in the Contract Time or the Contract Sum. The Contractor is responsible for substantiating its Claims. The word “Claim” shall not

include claims by the Owner. The Owner may withhold from the Contractor the value of any claims against the Contractor in accordance with Massachusetts General Laws, including, but not limited to, Sections 39G and 39K of Chapter 30.

15.1.2 Delete sub-section 15.1.2 and replace as follows:

§ 15.1.2 NOTICE OF CLAIMS
Contractor must initiate Claims within fourteen (14) calendar days after occurrence of the event giving rise to such Claim by written notice to the Architect and the Owner. Such written notice must (1) be signed by the Contractor; (2) conspicuously identify on its face that the notice serves as a notice of claim; (3) explain in sufficient detail the basis of the Claim; (4) identify the date of the event giving rise to such Claim; and (5) state the exact dollar amount of the increase in the Contract Sum being requested, if any, and the number of days extension to the Contract Time sought, if any.

15.1.3 Add after the word “Claim” as appearing in the first sentence as follows:

or any other dispute hereunder

Delete “Section 9.7 and” after “as provided in”.

Delete the final sentence.

15.1.5.1 In the second sentence delete “of cost and” after “include an estimate”.

15.1.5.2 Delete sub-section 15.1.5.2.

15.1.6 Delete sub-section 15.1.6.

15.2.1 In the third sentence:

Delete “mediation” after “condition precedent to” and replace with “litigation”.

Delete the end of the sentence beginning after “payment is due”.

15.2.2 Delete sub-section 15.2.2 and replace as follows:

§ 15.2.2 The Initial Decision Maker will review Claims and within 30 days of the receipt of the Claim take one or more of the following actions: (1) request additional supporting data from the Contractor; (2) notify the Contractor that the Initial Decision Maker requires additional time to resolve the Claim; and/or (3) reject the Claim in whole or in part.

15.2.3 Delete the last sentence.

15.2.4 Delete sub-section 15.2.4 and replace as follows:

> § 15.2.4 If the Architect requests the Contractor to furnish additional supporting data in connection with a Claim, the Contractor shall provide such data within ten (10) calendar days of such request. If the Contractor is of the opinion that it is impossible to provide such data within such time, the Contractor shall notify the Architect of such opinion in writing within such ten-day period. If the Architect determines that it is impossible for such data to be provided within such ten-day period through no fault of the Contractor, the Contractor shall provide such data within 30 calendar days of the Architect's request, unless the Architect fixes another date, in which case the data must be submitted by the date so fixed. Failure of the Contractor to provide such data within the time prescribed herein shall result in the irrevocable waiver of the Claim.

15.2.5 Delete the last sentence and replace as follows:

> The rejection of a claim by the Architect and any decisions of the Owner with respect to the same, and the interpretations by the Architect of the plans, drawings and specifications, shall be final and binding on the Contractor in accordance with Section 39J of Chapter 30 of the Massachusetts General Laws.

15.2.6 Delete sub-section 15.2.6 in is entirety.

15.2.7 Delete the capitalized word, "Claim," and replace with lower-case word, "claim," in the first and second sentences.

15.2.8 Delete sub-section 15.2.8.

15.3 Delete sections 15.3 and 15.4 in their entirety.
-15.4

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Section 00.73.36

FORM OF CONTRACTOR'S EQUAL EMPLOYMENT CERTIFICATION

This form must be completed and submitted by the Contractor prior to the signing of the Awarding Authority/Contractor Agreement.

This certifies that:

_____

Contractor

_____

Street Address

_____

City/State/Zip Code

1. Intends to use the following listed construction trades in the work under this contract:

   _____

   _____

   _____

   _____

   _____

   _____

2. Will comply with the affirmative action steps contained in Article 13 of the General Conditions of this Contract; and

3. Will obtain similar certifications from each of its subcontractors and submit to the Awarding Authority prior to the award of any subcontract under this contract the subcontractor's certification.

_____

Signature of Authorized Representative of Contractor

_____

Name and Title

_____

Date

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FORM OF SUBCONTRACTOR'S EQUAL EMPLOYMENT CERTIFICATION

This form must be completed and submitted by all Filed Subcontractors prior to the validation of the Awarding Authority/Contractor Agreement.

This certifies that:

_____
Name of Filed Subcontractor

_____
Street Address

_____
City/State/Zip Code

1. Intends to use the following listed construction trades in the work under this contract:

   _____

   _____

   _____

   _____

   _____

   _____

2. Will comply with the specific affirmative action steps contained in Article 13 of the Conditions of this Contract; and

3. Will obtain similar certifications from each of its subcontractors and submit to the Awarding Authority prior to the award of any subcontract under this contract the subcontractor's certification.

_____
Signature of Authorized Representative of Subcontractor

_____
Name and Title

_____
Date

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Section 00.73.43
WAGE RATE REQUIREMENTS

PART 1 -

1.1 WAGE RATES

A. The rate per hour to be paid to mechanics, apprentices, teamsters, chauffeurs, and laborers employed on the Work shall not be less than the rate of wages in the attached "Minimum Wage Rates" as determined by the Director of the Department of Labor and Work Force Development. This schedule shall continue to be the minimum rate of wages for said employees during the life of this Contract. Any questions relative to the applicability of any wage rate shall be directed to the Department of Labor and Workforce Development.

B. Keep posted on the site a legible copy of said schedule. Provide the Awarding Authority, on a weekly basis, and keep an on-site file of the wage rates and classifications of labor employed on this Work in order that they may be available for inspection by the Awarding Authority, Prime Designer or any other agency having jurisdiction.

C. Apprentices employed pursuant to this determination of wage rates must be registered and approved by the State Apprenticeship Council wherever rates for journeymen or apprentices are not listed.

D. Pay reserve police officers employed on the Work the prevailing rate of wages paid to regular police officers as required by MGL c149 § 34B, as amended. Such police officers shall be covered by Worker's Compensation Insurance and Employers Liability Insurance provided by the Contractor.

E. The Contractor and all subcontractors shall provide certified payroll affidavits verifying compliance with MGL c.149 §§26 - 27H.

F. The Contractor and all subcontractors shall provide a Statement of Compliance within 15 days of the completion of its portion of the work. This statement shall be submitted to the Awarding Authority on the form found elsewhere in this section.

G. The Contractor and all its subcontractors shall furnish to the Awarding Authority, with the first certified payroll report, documentation indicating that each employee has successfully completed 10 hours of a course in construction safety and health. This course must be approved by the United States Occupational Health and Safety Administration (OSHA)

SEE ATTACHED WAGE RATES
END OF SECTION

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THE COMMONWEALTH OF MASSACHUSETTS
EXECUTIVE OFFICE OF LABOR AND WORKFORCE DEVELOPMENT
DEPARTMENT OF LABOR STANDARDS

Prevailing Wage Rates

CHARLES D. BAKER
Governor

KARYN E. POLITO
Lt. Governor

As determined by the Director under the provisions of the Massachusetts General Laws, Chapter 149, Sections 26 to 27H

ROSALIN ACOSTA
Secretary

WILLIAM D MCKINNEY
Director

Awarding Authority: Town of Montague

Contract Number:

City/Town: MONTAGUE

Description of Work: Construction of a new 28,850 SF pre-engineered building that accommodates administrative space, vehicle repair bays, vehicle storage bays, truck wash, shops and storage.

Job Location: 180 Turners Falls Road, Montague, MA

Information about Prevailing Wage Schedules for Awarding Authorities and Contractors

- This wage schedule applies only to the specific project referenced at the top of this page and uniquely identified by the "Wage Request Number" on all pages of this schedule.
- An Awarding Authority must request an updated wage schedule from the Department of Labor Standards ("DLS") if it has not opened bids or selected a contractor within 90 days of the date of issuance of the wage schedule. For CM AT RISK projects (bid pursuant to G.L. c.149A), the earlier of: (a) the execution date of the GMP Amendment, or (b) the bid for the first construction scope of work must be within 90-days of the wage schedule issuance date.
- The wage schedule shall be incorporated in any advertisement or call for bids for the project as required by M.G.L. c. 149, § 27. The wage schedule shall be made a part of the contract awarded for the project. The wage schedule must be posted in a conspicuous place at the work site for the life of the project in accordance with M.G.L. c. 149 § 27. The wages listed on the wage schedule must be paid to employees performing construction work on the project whether they are employed by the prime contractor, a filed sub-bidder, or any sub-contractor.
- All apprentices working on the project are required to be registered with the Massachusetts Department of Labor Standards, Division of Apprentice Standards (DLS/DAS). Apprentice must keep his/her apprentice identification card on his/her person during all work hours on the project. An apprentice registered with DAS may be paid the lower apprentice wage rate at the applicable step as provided on the prevailing wage schedule. **Any apprentice not registered with DLS/DAS regardless of whether or not they are registered with any other federal, state, local, or private agency must be paid the journeyworker's rate for the trade.**
- The wage rates will remain in effect for the duration of the project, except in the case of multi-year public construction projects. For construction projects lasting longer than one year, awarding authorities must request an updated wage schedule. Awarding authorities are required to request these updates no later than two weeks before the anniversary of the date the contract was executed by the awarding authority and the general contractor. For multi-year CM AT RISK projects, awarding authority must request an annual update no later than two weeks before the anniversary date, determined as the earlier of: (a) the execution date of the GMP Amendment, or (b) the execution date of the first amendment to permit procurement of construction services. Contractors are required to obtain the wage schedules from awarding authorities, and to pay no less than these rates to covered workers. The annual update requirement is not applicable to 27F "rental of equipment" contracts.
- Every contractor or subcontractor which performs construction work on the project is required to submit weekly payroll reports and a Statement of Compliance directly to the awarding authority by mail or email and keep them on file for three years. Each weekly payroll report must contain: the employee's name, address, occupational classification, hours worked, and wages paid. Do not submit weekly payroll reports to DLS. A sample of a payroll reporting form may be obtained at http://www.mass.gov/dols/pw.
- Contractors with questions about the wage rates or classifications included on the wage schedule have an affirmative obligation to inquire with DLS at (617) 626-6953.
- Employees not receiving the prevailing wage rate set forth on the wage schedule may report the violation to the Fair Labor Division of the office of the Attorney General at (617) 727-3465.
- Failure of a contractor or subcontractor to pay the prevailing wage rates listed on the wage schedule to all employees who perform construction work on the project is a violation of the law and subjects the contractor or subcontractor to civil and

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
Construction						
(2 AXLE) DRIVER - EQUIPMENT *TEAMSTERS JOINT COUNCIL NO. 10 ZONE B*	12/01/2018	$33.25	$11.91	$12.70	$0.00	$57.86
	06/01/2019	$34.25	$11.91	$12.70	$0.00	$58.86
	08/01/2019	$34.25	$12.41	$12.70	$0.00	$59.36
	12/01/2019	$34.25	$12.41	$13.72	$0.00	$60.38
	06/01/2020	$35.15	$12.41	$13.72	$0.00	$61.28
	08/01/2020	$35.15	$12.91	$13.72	$0.00	$61.78
	12/01/2020	$35.15	$12.91	$14.82	$0.00	$62.88
	06/01/2021	$35.95	$12.91	$14.82	$0.00	$63.68
	08/01/2021	$35.95	$13.41	$14.82	$0.00	$64.18
	12/01/2021	$35.95	$13.41	$16.01	$0.00	$65.37
(3 AXLE) DRIVER - EQUIPMENT *TEAMSTERS JOINT COUNCIL NO. 10 ZONE B*	12/01/2018	$33.32	$11.91	$12.70	$0.00	$57.93
	06/01/2019	$34.32	$11.91	$12.70	$0.00	$58.93
	08/01/2019	$34.32	$12.41	$12.70	$0.00	$59.43
	12/01/2019	$34.32	$12.41	$13.72	$0.00	$60.45
	06/01/2020	$35.22	$12.41	$13.72	$0.00	$61.35
	08/01/2020	$35.22	$12.91	$13.72	$0.00	$61.85
	12/01/2020	$35.22	$12.91	$14.82	$0.00	$62.95
	06/01/2021	$36.02	$12.91	$14.82	$0.00	$63.75
	08/01/2021	$36.02	$13.41	$14.82	$0.00	$64.25
	12/01/2021	$36.02	$13.41	$16.01	$0.00	$65.44
(4 & 5 AXLE) DRIVER - EQUIPMENT *TEAMSTERS JOINT COUNCIL NO. 10 ZONE B*	12/01/2018	$33.44	$11.91	$12.70	$0.00	$58.05
	06/01/2019	$34.44	$11.91	$12.70	$0.00	$59.05
	08/01/2019	$34.44	$12.41	$12.70	$0.00	$59.55
	12/01/2019	$34.44	$12.41	$13.72	$0.00	$60.57
	06/01/2020	$35.34	$12.41	$13.72	$0.00	$61.47
	08/01/2020	$35.34	$12.91	$13.72	$0.00	$61.97
	12/01/2020	$35.34	$12.91	$14.82	$0.00	$63.07
	06/01/2021	$36.14	$12.91	$14.82	$0.00	$63.87
	08/01/2021	$36.14	$13.41	$14.82	$0.00	$64.37
	12/01/2021	$36.14	$13.41	$16.01	$0.00	$65.56
ADS/SUBMERSIBLE PILOT *PILE DRIVER LOCAL 56 (ZONE 3)*	08/01/2018	$97.80	$9.90	$21.15	$0.00	$128.85
	08/01/2019	$102.78	$9.90	$21.15	$0.00	$133.83
For apprentice rates see "Apprentice- PILE DRIVER"						
AIR TRACK OPERATOR *LABORERS - ZONE 3 (BUILDING & SITE)*	12/03/2018	$31.75	$7.85	$13.91	$0.00	$53.51
	06/03/2019	$32.56	$7.85	$13.91	$0.00	$54.32
	12/02/2019	$33.37	$7.85	$13.91	$0.00	$55.13
For apprentice rates see "Apprentice- LABORER"						
AIR TRACK OPERATOR (HEAVY & HIGHWAY) *LABORERS - ZONE 3 (HEAVY & HIGHWAY)*	12/01/2018	$31.75	$7.85	$11.89	$0.00	$51.49
	06/01/2019	$32.54	$7.85	$11.89	$0.00	$52.28
	12/01/2019	$33.33	$7.85	$11.89	$0.00	$53.07
	06/01/2020	$34.14	$7.85	$11.89	$0.00	$53.88
	12/01/2020	$34.95	$7.85	$11.89	$0.00	$54.69
	06/01/2021	$35.79	$7.85	$11.89	$0.00	$55.53
	12/01/2021	$36.62	$7.85	$11.89	$0.00	$56.36
For apprentice rates see "Apprentice- LABORER (Heavy and Highway)"						

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
ASBESTOS WORKER (PIPES & TANKS) *HEAT & FROST INSULATORS LOCAL 6 (SPRINGFIELD)*	12/01/2018	$31.86	$12.50	$8.00	$0.00	$52.36
	06/01/2019	$32.76	$12.50	$8.00	$0.00	$53.26
	12/01/2019	$33.66	$12.50	$8.00	$0.00	$54.16
	06/01/2020	$34.56	$12.50	$8.00	$0.00	$55.06
	12/01/2020	$35.46	$12.50	$8.00	$0.00	$55.96
ASPHALT RAKER *LABORERS - ZONE 3 (BUILDING & SITE)*	12/03/2018	$31.25	$7.85	$13.91	$0.00	$53.01
	06/03/2019	$32.06	$7.85	$13.91	$0.00	$53.82
	12/02/2019	$32.87	$7.85	$13.91	$0.00	$54.63
For apprentice rates see "Apprentice- LABORER"						
ASPHALT RAKER (HEAVY & HIGHWAY) *LABORERS - ZONE 3 (HEAVY & HIGHWAY)*	12/01/2018	$31.25	$7.85	$11.89	$0.00	$50.99
	06/01/2019	$32.04	$7.85	$11.89	$0.00	$51.78
	12/01/2019	$32.83	$7.85	$11.89	$0.00	$52.57
	06/01/2020	$33.64	$7.85	$11.89	$0.00	$53.38
	12/01/2020	$34.45	$7.85	$11.89	$0.00	$54.19
	06/01/2021	$35.29	$7.85	$11.89	$0.00	$55.03
	12/01/2021	$36.12	$7.85	$11.89	$0.00	$55.86
For apprentice rates see "Apprentice- LABORER (Heavy and Highway)"						
AUTOMATIC GRADER-EXCAVATOR (RECLAIMER) *OPERATING ENGINEERS LOCAL 98*	12/01/2018	$34.79	$11.44	$13.81	$0.00	$60.04
	06/01/2019	$35.05	$11.69	$14.08	$0.00	$60.82
	12/01/2019	$35.65	$11.69	$14.35	$0.00	$61.69
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
BACKHOE/FRONT-END LOADER OPERATOR *OPERATING ENGINEERS LOCAL 98*	12/01/2018	$34.79	$11.44	$13.81	$0.00	$60.04
	06/01/2019	$35.05	$11.69	$14.08	$0.00	$60.82
	12/01/2019	$35.65	$11.69	$14.35	$0.00	$61.69
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
BARCO-TYPE JUMPING TAMPER *LABORERS - ZONE 3 (BUILDING & SITE)*	12/03/2018	$31.25	$7.85	$13.91	$0.00	$53.01
	06/03/2019	$32.06	$7.85	$13.91	$0.00	$53.82
	12/02/2019	$32.87	$7.85	$13.91	$0.00	$54.63
For apprentice rates see "Apprentice- LABORER"						
BATCH/CEMENT PLANT - ON SITE *OPERATING ENGINEERS LOCAL 98*	12/01/2018	$34.26	$11.44	$13.81	$0.00	$59.51
	06/01/2019	$34.52	$11.69	$14.08	$0.00	$60.29
	12/01/2019	$35.12	$11.69	$14.35	$0.00	$61.16
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
BLOCK PAVER, RAMMER / CURB SETTER *LABORERS - ZONE 3 (BUILDING & SITE)*	12/03/2018	$31.75	$7.85	$13.91	$0.00	$53.51
	06/03/2019	$32.56	$7.85	$13.91	$0.00	$54.32
	12/02/2019	$33.37	$7.85	$13.91	$0.00	$55.13
For apprentice rates see "Apprentice- LABORER"						
BLOCK PAVER, RAMMER / CURB SETTER (HEAVY & HIGHWAY) *LABORERS - ZONE 3 (HEAVY & HIGHWAY)*	12/01/2018	$31.75	$7.85	$11.89	$0.00	$51.49
	06/01/2019	$32.54	$7.85	$11.89	$0.00	$52.28
	12/01/2019	$33.33	$7.85	$11.89	$0.00	$53.07
	06/01/2020	$34.14	$7.85	$11.89	$0.00	$53.88
	12/01/2020	$34.95	$7.85	$11.89	$0.00	$54.69
	06/01/2021	$35.79	$7.85	$11.89	$0.00	$55.53
	12/01/2021	$36.62	$7.85	$11.89	$0.00	$56.36
For apprentice rates see "Apprentice- LABORER (Heavy and Highway)"						
BOILER MAKER *BOILERMAKERS LOCAL 29*	01/01/2019	$44.71	$7.07	$17.72	$0.00	$69.50
	01/01/2020	$46.10	$7.07	$17.98	$0.00	$71.15

Apprentice - *BOILERMAKER - Local 29*

Effective Date - 01/01/2019

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	65	$29.06	$7.07	$11.52	$0.00	$47.65
2	65	$29.06	$7.07	$11.52	$0.00	$47.65
3	70	$31.30	$7.07	$12.40	$0.00	$50.77
4	75	$33.53	$7.07	$13.30	$0.00	$53.90
5	80	$35.77	$7.07	$14.18	$0.00	$57.02
6	85	$38.00	$7.07	$15.07	$0.00	$60.14
7	90	$40.24	$7.07	$15.95	$0.00	$63.26
8	95	$42.47	$7.07	$16.84	$0.00	$66.38

Effective Date - 01/01/2020

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

Notes:

Apprentice to Journeyworker Ratio:1:4

BRICK/STONE/ARTIFICIAL MASONRY (INCL. MASONRY WATERPROOFING) *BRICKLAYERS LOCAL 3 (SPRINGFIELD/PITTSFIELD)*	02/01/2019	$41.96	$10.75	$18.77	$0.00	$71.48
	08/01/2019	$43.31	$10.75	$18.91	$0.00	$72.97
	02/01/2020	$43.86	$10.75	$18.91	$0.00	$73.52
	08/01/2020	$45.21	$10.75	$19.06	$0.00	$75.02
	02/01/2021	$45.76	$10.75	$19.06	$0.00	$75.57
	08/01/2021	$47.16	$10.75	$19.22	$0.00	$77.13
	02/01/2022	$47.69	$10.75	$19.22	$0.00	$77.66

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate

Apprentice - *BRICK/PLASTER/CEMENT MASON - Local 3 Springfield/Pittsfield*

Effective Date - 02/01/2019

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	$20.98	$10.75	$18.77	$0.00	$50.50
2	60	$25.18	$10.75	$18.77	$0.00	$54.70
3	70	$29.37	$10.75	$18.77	$0.00	$58.89
4	80	$33.57	$10.75	$18.77	$0.00	$63.09
5	90	$37.76	$10.75	$18.77	$0.00	$67.28

Effective Date - 08/01/2019

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	$21.66	$10.75	$18.91	$0.00	$51.32
2	60	$25.99	$10.75	$18.91	$0.00	$55.65
3	70	$30.32	$10.75	$18.91	$0.00	$59.98
4	80	$34.65	$10.75	$18.91	$0.00	$64.31
5	90	$38.98	$10.75	$18.91	$0.00	$68.64

Notes:

Apprentice to Journeyworker Ratio:1:5

BULLDOZER/POWER SHOVEL/TREE SHREDDER /CLAM SHELL *OPERATING ENGINEERS LOCAL 98*	12/01/2018	$34.79	$11.44	$13.81	$0.00	$60.04
	06/01/2019	$35.05	$11.69	$14.08	$0.00	$60.82
	12/01/2019	$35.65	$11.69	$14.35	$0.00	$61.69
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
CAISSON & UNDERPINNING BOTTOM MAN *LABORERS - FOUNDATION AND MARINE*	12/01/2018	$39.75	$7.85	$15.55	$0.00	$63.15
	06/01/2019	$40.75	$7.85	$15.55	$0.00	$64.15
	12/01/2019	$41.75	$7.85	$15.55	$0.00	$65.15
	06/01/2020	$42.74	$7.85	$15.55	$0.00	$66.14
	12/01/2020	$43.72	$7.85	$15.55	$0.00	$67.12
	06/01/2021	$44.74	$7.85	$15.55	$0.00	$68.14
	12/01/2021	$45.75	$7.85	$15.55	$0.00	$69.15
For apprentice rates see "Apprentice- LABORER"						
CAISSON & UNDERPINNING LABORER *LABORERS - FOUNDATION AND MARINE*	12/01/2018	$38.60	$7.85	$15.55	$0.00	$62.00
	06/01/2019	$39.60	$7.85	$15.55	$0.00	$63.00
	12/01/2019	$40.60	$7.85	$15.55	$0.00	$64.00
	06/01/2020	$41.59	$7.85	$15.55	$0.00	$64.99
	12/01/2020	$42.57	$7.85	$15.55	$0.00	$65.97
	06/01/2021	$43.59	$7.85	$15.55	$0.00	$66.99
	12/01/2021	$44.60	$7.85	$15.55	$0.00	$68.00
For apprentice rates see "Apprentice- LABORER"						

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
CAISSON & UNDERPINNING TOP MAN *LABORERS - FOUNDATION AND MARINE*	12/01/2018	$38.60	$7.85	$15.55	$0.00	$62.00
	06/01/2019	$39.60	$7.85	$15.55	$0.00	$63.00
	12/01/2019	$40.60	$7.85	$15.55	$0.00	$64.00
	06/01/2020	$41.59	$7.85	$15.55	$0.00	$64.99
	12/01/2020	$42.57	$7.85	$15.55	$0.00	$65.97
	06/01/2021	$43.59	$7.85	$15.55	$0.00	$66.99
	12/01/2021	$44.60	$7.85	$15.55	$0.00	$68.00
For apprentice rates see "Apprentice- LABORER"						
CARBIDE CORE DRILL OPERATOR *LABORERS - ZONE 3 (BUILDING & SITE)*	12/03/2018	$31.25	$7.85	$13.91	$0.00	$53.01
	06/03/2019	$32.06	$7.85	$13.91	$0.00	$53.82
	12/02/2019	$32.87	$7.85	$13.91	$0.00	$54.63
For apprentice rates see "Apprentice- LABORER"						
CARPENTER *CARPENTERS LOCAL 108 - HAMPDEN HAMPSHIRE FRANKLIN*	03/04/2019	$38.64	$8.26	$15.00	$0.00	$61.90

Apprentice - *CARPENTER - Local 108 Hampden Hampshire Franklin*

Effective Date - 03/04/2019

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	$19.32	$8.26	$1.22	$0.00	$28.80
2	60	$23.18	$8.26	$1.22	$0.00	$32.66
3	70	$27.05	$8.26	$11.34	$0.00	$46.65
4	75	$28.98	$8.26	$11.34	$0.00	$48.58
5	80	$30.91	$8.26	$12.56	$0.00	$51.73
6	80	$30.91	$8.26	$12.56	$0.00	$51.73
7	90	$34.78	$8.26	$13.78	$0.00	$56.82
8	90	$34.78	$8.26	$13.78	$0.00	$56.82

Notes:

% Indentured After 10/1/17; 45/45/55/55/70/70/80/80
Step 1&2 $25.93/ 3&4 $30.77/ 5&6 $46.41/ 7&8 $51.29

Apprentice to Journeyworker Ratio:1:5

CARPENTER WOOD FRAME *CARPENTERS LOCAL 108 - HAMPDEN HAMPSHIRE FRANKLIN*	04/01/2019	$23.10	$7.07	$7.86	$0.00	$38.03
	10/01/2019	$23.49	$7.07	$7.86	$0.00	$38.42
All Aspects of New Wood Frame Work						

Apprentice - *CARPENTER (Wood Frame) - 108 Hampden Hampshire*

Effective Date - 04/01/2019

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	60	$13.86	$7.07	$0.00	$0.00	$20.93
2	60	$13.86	$7.07	$0.00	$0.00	$20.93
3	65	$15.02	$7.07	$7.86	$0.00	$29.95
4	70	$16.17	$7.07	$7.86	$0.00	$31.10
5	75	$17.33	$7.07	$7.86	$0.00	$32.26
6	80	$18.48	$7.07	$7.86	$0.00	$33.41
7	85	$19.64	$7.07	$7.86	$0.00	$34.57
8	90	$20.79	$7.07	$7.86	$0.00	$35.72

Effective Date - 10/01/2019

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	60	$14.09	$7.07	$0.00	$0.00	$21.16
2	60	$14.09	$7.07	$0.00	$0.00	$21.16
3	65	$15.27	$7.07	$7.86	$0.00	$30.20
4	70	$16.44	$7.07	$7.86	$0.00	$31.37
5	75	$17.62	$7.07	$7.86	$0.00	$32.55
6	80	$18.79	$7.07	$7.86	$0.00	$33.72
7	85	$19.97	$7.07	$7.86	$0.00	$34.90
8	90	$21.14	$7.07	$7.86	$0.00	$36.07

Notes:

% Indentured After 10/1/17; 45/45/55/55/70/70/80/80
Step 1&2 $17.47/ 3&4 $24.53/ 5&6 $31.10/ 7&8 $33.41

Apprentice to Journeyworker Ratio:1:5

CEMENT MASONRY/PLASTERING *BRICKLAYERS LOCAL 3 (SPRINGFIELD/PITTSFIELD)*	01/01/2019	$40.46	$12.45	$17.64	$0.30	$70.85
	07/01/2019	$41.03	$12.45	$17.64	$0.30	$71.42
	01/01/2020	$42.51	$12.45	$17.64	$0.30	$72.90

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate

Apprentice - *CEMENT MASONRY/PLASTERING - Springfield/Pittsfield*

Effective Date - 01/01/2019

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	$20.23	$12.45	$15.41	$0.00	$48.09
2	60	$24.28	$12.45	$17.64	$0.30	$54.67
3	65	$26.30	$12.45	$17.64	$0.30	$56.69
4	70	$28.32	$12.45	$17.64	$0.30	$58.71
5	75	$30.35	$12.45	$17.64	$0.30	$60.74
6	80	$32.37	$12.45	$17.64	$0.30	$62.76
7	90	$36.41	$12.45	$17.64	$0.30	$66.80

Effective Date - 07/01/2019

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	$20.52	$12.45	$15.41	$0.00	$48.38
2	60	$24.62	$12.45	$17.64	$0.30	$55.01
3	65	$26.67	$12.45	$17.64	$0.30	$57.06
4	70	$28.72	$12.45	$17.64	$0.30	$59.11
5	75	$30.77	$12.45	$17.64	$0.30	$61.16
6	80	$32.82	$12.45	$17.64	$0.30	$63.21
7	90	$36.93	$12.45	$17.64	$0.30	$67.32

Notes:

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

Apprentice to Journeyworker Ratio:1:3

CHAIN SAW OPERATOR *LABORERS - ZONE 3 (BUILDING & SITE)*		12/03/2018	$31.25	$7.85	$13.91	$0.00	$53.01
		06/03/2019	$32.06	$7.85	$13.91	$0.00	$53.82
		12/02/2019	$32.87	$7.85	$13.91	$0.00	$54.63
For apprentice rates see "Apprentice- LABORER"							
COMPRESSOR OPERATOR *OPERATING ENGINEERS LOCAL 98*		12/01/2018	$34.26	$11.44	$13.81	$0.00	$59.51
		06/01/2019	$34.52	$11.69	$14.08	$0.00	$60.29
		12/01/2019	$35.12	$11.69	$14.35	$0.00	$61.16
For apprentice rates see "Apprentice- OPERATING ENGINEERS"							
CRANE OPERATOR *OPERATING ENGINEERS LOCAL 98*		12/01/2018	$38.29	$11.44	$13.81	$0.00	$63.54
		06/01/2019	$38.55	$11.69	$14.08	$0.00	$64.32
		12/01/2019	$39.15	$11.69	$14.35	$0.00	$65.19
For apprentice rates see "Apprentice- OPERATING ENGINEERS"							
DELEADER (BRIDGE) *PAINTERS LOCAL 35 - ZONE 3*		01/01/2019	$50.36	$8.15	$20.85	$0.00	$79.36
		07/01/2019	$51.46	$8.15	$20.85	$0.00	$80.46
		01/01/2020	$42.56	$8.15	$20.85	$0.00	$71.56
		07/01/2020	$53.66	$8.15	$20.85	$0.00	$82.66
		01/01/2021	$54.76	$8.15	$20.85	$0.00	$83.76

Apprentice - *PAINTER Local 35 - BRIDGES/TANKS*

Effective Date - 01/01/2019

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	$25.18	$8.15	$0.00	$0.00	$33.33
2	55	$27.70	$8.15	$5.64	$0.00	$41.49
3	60	$30.22	$8.15	$6.15	$0.00	$44.52
4	65	$32.73	$8.15	$6.66	$0.00	$47.54
5	70	$35.25	$8.15	$17.78	$0.00	$61.18
6	75	$37.77	$8.15	$18.29	$0.00	$64.21
7	80	$40.29	$8.15	$18.80	$0.00	$67.24
8	90	$45.32	$8.15	$19.83	$0.00	$73.30

Effective Date - 07/01/2019

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	$25.73	$8.15	$0.00	$0.00	$33.88
2	55	$28.30	$8.15	$5.64	$0.00	$42.09
3	60	$30.88	$8.15	$6.15	$0.00	$45.18
4	65	$33.45	$8.15	$6.66	$0.00	$48.26
5	70	$36.02	$8.15	$17.78	$0.00	$61.95
6	75	$38.60	$8.15	$18.29	$0.00	$65.04
7	80	$41.17	$8.15	$18.80	$0.00	$68.12
8	90	$46.31	$8.15	$19.83	$0.00	$74.29

Notes:
Steps are 750 hrs.

Apprentice to Journeyworker Ratio:1:1

DEMO: ADZEMAN *LABORERS - ZONE 3 (BUILDING & SITE)*	12/01/2018	$38.80	$7.85	$15.35	$0.00	$62.00
	06/01/2019	$39.80	$7.85	$15.35	$0.00	$63.00
	12/01/2019	$40.80	$7.85	$15.35	$0.00	$64.00
For apprentice rates see "Apprentice- LABORER"						
DEMO: BACKHOE/LOADER/HAMMER OPERATOR *LABORERS - ZONE 3 (BUILDING & SITE)*	12/01/2018	$39.80	$7.85	$15.35	$0.00	$63.00
	06/01/2019	$40.80	$7.85	$15.35	$0.00	$64.00
	12/01/2019	$41.80	$7.85	$15.35	$0.00	$65.00
For apprentice rates see "Apprentice- LABORER"						
DEMO: BURNERS *LABORERS - ZONE 3 (BUILDING & SITE)*	12/01/2018	$39.55	$7.85	$15.35	$0.00	$62.75
	06/01/2019	$40.55	$7.85	$15.35	$0.00	$63.75
	12/01/2019	$41.55	$7.85	$15.35	$0.00	$64.75
For apprentice rates see "Apprentice- LABORER"						
DEMO: CONCRETE CUTTER/SAWYER *LABORERS - ZONE 3 (BUILDING & SITE)*	12/01/2018	$39.80	$7.85	$15.35	$0.00	$63.00
	06/01/2019	$40.80	$7.85	$15.35	$0.00	$64.00
	12/01/2019	$41.80	$7.85	$15.35	$0.00	$65.00
For apprentice rates see "Apprentice- LABORER"						

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
DEMO: JACKHAMMER OPERATOR *LABORERS - ZONE 3 (BUILDING & SITE)*	12/01/2018	$39.55	$7.85	$15.35	$0.00	$62.75
	06/01/2019	$40.55	$7.85	$15.35	$0.00	$63.75
	12/01/2019	$41.55	$7.85	$15.35	$0.00	$64.75
For apprentice rates see "Apprentice- LABORER"						
DEMO: WRECKING LABORER *LABORERS - ZONE 3 (BUILDING & SITE)*	12/01/2018	$38.80	$7.85	$15.35	$0.00	$62.00
	06/01/2019	$39.80	$7.85	$15.35	$0.00	$63.00
	12/01/2019	$40.80	$7.85	$15.35	$0.00	$64.00
For apprentice rates see "Apprentice- LABORER"						
DIVER *PILE DRIVER LOCAL 56 (ZONE 3)*	08/01/2018	$65.20	$9.90	$21.15	$0.00	$96.25
	08/01/2019	$68.52	$9.90	$21.15	$0.00	$99.57
For apprentice rates see "Apprentice- PILE DRIVER"						
DIVER TENDER *PILE DRIVER LOCAL 56 (ZONE 3)*	08/01/2018	$46.57	$9.90	$21.15	$0.00	$77.62
	08/01/2019	$48.94	$9.90	$21.15	$0.00	$79.99
For apprentice rates see "Apprentice- PILE DRIVER"						
DIVER TENDER (EFFLUENT) *PILE DRIVER LOCAL 56 (ZONE 3)*	08/01/2018	$69.86	$9.90	$21.15	$0.00	$100.91
	08/01/2019	$73.41	$9.90	$21.15	$0.00	$104.46
For apprentice rates see "Apprentice- PILE DRIVER"						
DIVER/SLURRY (EFFLUENT) *PILE DRIVER LOCAL 56 (ZONE 3)*	08/01/2018	$97.80	$9.90	$21.15	$0.00	$128.85
	08/01/2019	$102.78	$9.90	$21.15	$0.00	$133.83
For apprentice rates see "Apprentice- PILE DRIVER"						
ELECTRICIAN (Including Core Drilling) *ELECTRICIANS LOCAL 7*	12/30/2018	$41.91	$10.50	$12.06	$0.00	$64.47
	06/30/2019	$42.66	$10.75	$12.33	$0.00	$65.74
	12/29/2019	$43.41	$11.00	$12.60	$0.00	$67.01

Apprentice - *ELECTRICIAN - Local 7*

Effective Date - 12/30/2018

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	40	$16.76	$5.70	$0.50	$0.00	$22.96
2	45	$18.86	$5.70	$0.57	$0.00	$25.13
3	50	$20.96	$10.50	$6.93	$0.00	$38.39
4	55	$23.05	$10.50	$6.99	$0.00	$40.54
5	65	$27.24	$10.50	$8.12	$0.00	$45.86
6	70	$29.34	$10.50	$9.18	$0.00	$49.02

Effective Date - 06/30/2019

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	40	$17.06	$5.85	$0.51	$0.00	$23.42
2	45	$19.20	$5.85	$0.58	$0.00	$25.63
3	50	$21.33	$10.75	$6.94	$0.00	$39.02
4	55	$23.46	$10.75	$7.00	$0.00	$41.21
5	65	$27.73	$10.75	$8.13	$0.00	$46.61
6	70	$29.86	$10.75	$9.20	$0.00	$49.81

Notes:

Steps 1-2 are 1000 hrs; Steps 3-6 are 1500 hrs.

Apprentice to Journeyworker Ratio:2:3****

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
ELEVATOR CONSTRUCTOR *ELEVATOR CONSTRUCTORS LOCAL 41*	01/01/2019	$53.11	$15.58	$17.51	$0.00	$86.20
	01/01/2020	$54.85	$15.73	$18.41	$0.00	$88.99
	01/01/2021	$56.69	$15.88	$19.31	$0.00	$91.88
	01/01/2022	$58.62	$16.03	$20.21	$0.00	$94.86

Apprentice - *ELEVATOR CONSTRUCTOR - Local 41*

Effective Date - 01/01/2019

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	$26.56	$15.58	$0.00	$0.00	$42.14
2	55	$29.21	$15.58	$17.51	$0.00	$62.30
3	65	$34.52	$15.58	$17.51	$0.00	$67.61
4	70	$37.18	$15.58	$17.51	$0.00	$70.27
5	80	$42.49	$15.58	$17.51	$0.00	$75.58

Effective Date - 01/01/2020

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	$27.43	$15.73	$0.00	$0.00	$43.16
2	55	$30.17	$15.73	$18.41	$0.00	$64.31
3	65	$35.65	$15.73	$18.41	$0.00	$69.79
4	70	$38.40	$15.73	$18.41	$0.00	$72.54
5	80	$43.88	$15.73	$18.41	$0.00	$78.02

Notes:

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

Apprentice to Journeyworker Ratio:1:1

ELEVATOR CONSTRUCTOR HELPER *ELEVATOR CONSTRUCTORS LOCAL 41*	01/01/2019	$37.18	$15.58	$17.51	$0.00	$70.27
	01/01/2020	$38.40	$15.73	$18.41	$0.00	$72.54
	01/01/2021	$39.68	$15.88	$19.31	$0.00	$74.87
	01/01/2022	$41.03	$16.03	$20.21	$0.00	$77.27
For apprentice rates see "Apprentice - ELEVATOR CONSTRUCTOR"						
FENCE & GUARD RAIL ERECTOR (HEAVY & HIGHWAY) *LABORERS - ZONE 3 (HEAVY & HIGHWAY)*	12/01/2018	$31.25	$7.85	$11.89	$0.00	$50.99
	06/01/2019	$32.04	$7.85	$11.89	$0.00	$51.78
	12/01/2019	$32.83	$7.85	$11.89	$0.00	$52.57
	06/01/2020	$33.64	$7.85	$11.89	$0.00	$53.38
	12/01/2020	$34.45	$7.85	$11.89	$0.00	$54.19
	06/01/2021	$35.29	$7.85	$11.89	$0.00	$55.03
	12/01/2021	$36.12	$7.85	$11.89	$0.00	$55.86
For apprentice rates see "Apprentice- LABORER (Heavy and Highway)"						
FIELD ENG.INST/ROD-BLDG,SITE,HVY/HWY *OPERATING ENGINEERS LOCAL 98*	06/01/1999	$18.84	$4.80	$4.10	$0.00	$27.74
FIELD ENG.PARTY CHIEF:BLDG,SITE,HVY/HWY *OPERATING ENGINEERS LOCAL 98*	06/01/1999	$21.33	$4.80	$4.10	$0.00	$30.23
FIELD ENG.SURVEY CHIEF-BLDG,SITE,HVY/HWY *OPERATING ENGINEERS LOCAL 98*	06/01/1999	$22.33	$4.80	$4.10	$0.00	$31.23

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
FIRE ALARM INSTALLER *ELECTRICIANS LOCAL 7*	12/30/2018	$41.91	$10.50	$12.06	$0.00	$64.47
	06/30/2019	$42.66	$10.75	$12.33	$0.00	$65.74
	12/29/2019	$43.41	$11.00	$12.60	$0.00	$67.01
For apprentice rates see "Apprentice- ELECTRICIAN"						
FIRE ALARM REPAIR / MAINTENANCE / COMMISSIONING*ELECTRICIANS LOCAL 7*	12/30/2018	$41.91	$10.50	$12.06	$0.00	$64.47
	06/30/2019	$42.66	$10.75	$12.33	$0.00	$65.74
	12/29/2019	$43.41	$11.00	$12.60	$0.00	$67.01
For apprentice rates see "Apprentice- TELECOMMUNICATIONS TECHNICIAN"						
FIREMAN *OPERATING ENGINEERS LOCAL 98*	12/01/2018	$34.26	$11.44	$13.81	$0.00	$59.51
	06/01/2019	$34.52	$11.69	$14.08	$0.00	$60.29
	12/01/2019	$35.12	$11.69	$14.35	$0.00	$61.16

Apprentice - *OPERATING ENGINEERS - Local 98 Class 3*

Effective Date - 12/01/2018

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	60	$20.56	$11.44	$13.81	$0.00	$45.81
2	70	$23.98	$11.44	$13.81	$0.00	$49.23
3	80	$27.41	$11.44	$13.81	$0.00	$52.66
4	90	$30.83	$11.44	$13.81	$0.00	$56.08

Effective Date - 06/01/2019

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	60	$20.71	$11.69	$14.08	$0.00	$46.48
2	70	$24.16	$11.69	$14.08	$0.00	$49.93
3	80	$27.62	$11.69	$14.08	$0.00	$53.39
4	90	$31.07	$11.69	$14.08	$0.00	$56.84

Notes:

Steps 1-2 are 1000 hrs.; Steps 3-4 are 2000 hrs.

Apprentice to Journeyworker Ratio:1:6

FLAGGER & SIGNALER (HEAVY & HIGHWAY) *LABORERS - ZONE 3 (HEAVY & HIGHWAY)*	12/01/2018	$22.50	$7.85	$11.89	$0.00	$42.24
	06/01/2019	$22.50	$7.85	$11.89	$0.00	$42.24
	12/01/2019	$23.50	$7.85	$11.89	$0.00	$43.24
	06/01/2020	$23.50	$7.85	$11.89	$0.00	$43.24
	12/01/2020	$24.50	$7.85	$11.89	$0.00	$44.24
	06/01/2021	$24.50	$7.85	$11.89	$0.00	$44.24
	12/01/2021	$24.50	$7.85	$11.89	$0.00	$44.24
For apprentice rates see "Apprentice- LABORER (Heavy and Highway)						
FLOORCOVERER *FLOORCOVERERS LOCAL 2168 ZONE III*	03/01/2016	$32.60	$8.55	$14.42	$0.00	$55.57

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate

Apprentice - *FLOORCOVERER - Local 2168 Zone III*

Effective Date - 03/01/2016

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	$16.30	$8.55	$1.20	$0.00	$26.05
2	55	$17.93	$8.55	$1.20	$0.00	$27.68
3	60	$19.56	$8.55	$10.82	$0.00	$38.93
4	65	$21.19	$8.55	$10.82	$0.00	$40.56
5	70	$22.82	$8.55	$12.02	$0.00	$43.39
6	75	$24.45	$8.55	$12.02	$0.00	$45.02
7	80	$26.08	$8.55	$13.22	$0.00	$47.85
8	85	$27.71	$8.55	$13.22	$0.00	$49.48

Notes: Steps are 750 hrs.
% After 09/1/17; 45/45/55/55/70/70/80/80 (1500hr Steps)
Step 1&2 $24.42/ 3&4 $28.84/ 5&6 $43.39/ 7&8 $47.85

Apprentice to Journeyworker Ratio:1:1

FORK LIFT *OPERATING ENGINEERS LOCAL 98*	12/01/2018	$34.48	$11.44	$13.81	$0.00	$59.73
	06/01/2019	$34.74	$11.69	$14.08	$0.00	$60.51
	12/01/2019	$35.34	$11.69	$14.35	$0.00	$61.38
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
GENERATORS/LIGHTING PLANTS *OPERATING ENGINEERS LOCAL 98*	12/01/2018	$31.03	$11.44	$13.81	$0.00	$56.28
	06/01/2019	$31.29	$11.69	$14.08	$0.00	$57.06
	12/01/2019	$31.89	$11.69	$14.35	$0.00	$57.93
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
GLAZIER (GLASS PLANK/AIR BARRIER/INTERIOR SYSTEMS) *GLAZIERS LOCAL 1333*	06/01/2018	$37.18	$10.40	$9.35	$0.00	$56.93
	06/01/2019	$38.18	$10.60	$9.90	$0.00	$58.68
	06/01/2020	$39.18	$10.80	$10.45	$0.00	$60.43

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate

Apprentice - *GLAZIER - Local 1333*

Effective Date - 06/01/2018

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	$18.59	$10.40	$1.60	$0.00	$30.59
2	56	$20.91	$10.40	$1.60	$0.00	$32.91
3	63	$23.24	$10.40	$2.10	$0.00	$35.74
4	69	$25.56	$10.40	$2.10	$0.00	$38.06
5	75	$27.89	$10.40	$2.60	$0.00	$40.89
6	81	$30.21	$10.40	$2.60	$0.00	$43.21
7	88	$32.53	$10.40	$9.35	$0.00	$52.28
8	94	$34.86	$10.40	$9.35	$0.00	$54.61

Effective Date - 06/01/2019

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	$19.09	$10.60	$1.80	$0.00	$31.49
2	56	$21.48	$10.60	$1.80	$0.00	$33.88
3	63	$23.86	$10.60	$2.40	$0.00	$36.86
4	69	$26.25	$10.60	$2.40	$0.00	$39.25
5	75	$28.64	$10.60	$2.90	$0.00	$42.14
6	81	$31.02	$10.60	$2.90	$0.00	$44.52
7	88	$33.41	$10.60	$9.90	$0.00	$53.91
8	94	$35.79	$10.60	$9.90	$0.00	$56.29

Notes:

Apprentice to Journeyworker Ratio:1:3

GRADER/TRENCHING MACHINE/DERRICK *OPERATING ENGINEERS LOCAL 98*	12/01/2018	$34.79	$11.44	$13.81	$0.00	$60.04
	06/01/2019	$35.05	$11.69	$14.08	$0.00	$60.82
	12/01/2019	$35.65	$11.69	$14.35	$0.00	$61.69
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
HVAC (DUCTWORK) *SHEETMETAL WORKERS LOCAL 63*	01/01/2019	$34.74	$10.64	$16.22	$1.77	$63.37
	07/01/2019	$35.74	$10.64	$16.22	$1.77	$64.37
	01/01/2020	$36.99	$10.64	$16.22	$1.77	$65.62
For apprentice rates see "Apprentice- SHEET METAL WORKER"						
HVAC (ELECTRICAL CONTROLS) *ELECTRICIANS LOCAL 7*	12/30/2018	$41.91	$10.50	$12.06	$0.00	$64.47
	06/30/2019	$42.66	$10.75	$12.33	$0.00	$65.74
	12/29/2019	$43.41	$11.00	$12.60	$0.00	$67.01
For apprentice rates see "Apprentice- ELECTRICIAN"						
HVAC (TESTING AND BALANCING - AIR) *SHEETMETAL WORKERS LOCAL 63*	01/01/2019	$34.74	$10.64	$16.22	$1.77	$63.37
	07/01/2019	$35.74	$10.64	$16.22	$1.77	$64.37
	01/01/2020	$36.99	$10.64	$16.22	$1.77	$65.62
For apprentice rates see "Apprentice- SHEET METAL WORKER"						
HVAC (TESTING AND BALANCING -WATER) *PLUMBERS & PIPEFITTERS LOCAL 104*	03/17/2019	$40.21	$8.75	$16.35	$0.00	$65.31
For apprentice rates see "Apprentice- PIPEFITTER" or "PLUMBER/PIPEFITTER"						

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
HVAC MECHANIC *PLUMBERS & PIPEFITTERS LOCAL 104*	03/17/2019	$40.21	$8.75	$16.35	$0.00	$65.31
For apprentice rates see "Apprentice- PIPEFITTER" or "PLUMBER/PIPEFITTER"						
HYDRAULIC DRILLS (HEAVY & HIGHWAY) *LABORERS - ZONE 3 (HEAVY & HIGHWAY)*	12/01/2018	$31.75	$7.85	$11.89	$0.00	$51.49
	06/01/2019	$32.54	$7.85	$11.89	$0.00	$52.28
	12/01/2019	$33.33	$7.85	$11.89	$0.00	$53.07
	06/01/2020	$34.14	$7.85	$11.89	$0.00	$53.88
	12/01/2020	$34.95	$7.85	$11.89	$0.00	$54.69
	06/01/2021	$35.79	$7.85	$11.89	$0.00	$55.53
	12/01/2021	$36.62	$7.85	$11.89	$0.00	$56.36
For apprentice rates see "Apprentice- LABORER (Heavy and Highway)						
INSULATOR (PIPES & TANKS) *HEAT & FROST INSULATORS LOCAL 6 (SPRINGFIELD)*	09/01/2018	$37.67	$12.50	$15.60	$0.00	$65.77
	09/01/2019	$39.67	$12.50	$15.60	$0.00	$67.77

Apprentice - *ASBESTOS INSULATOR (Pipes & Tanks) - Local 6 Springfield*

Effective Date - 09/01/2018

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	$18.84	$12.50	$11.40	$0.00	$42.74
2	60	$22.60	$12.50	$12.24	$0.00	$47.34
3	70	$26.37	$12.50	$13.08	$0.00	$51.95
4	80	$30.14	$12.50	$13.92	$0.00	$56.56

Effective Date - 09/01/2019

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	$19.84	$12.50	$11.40	$0.00	$43.74
2	60	$23.80	$12.50	$12.24	$0.00	$48.54
3	70	$27.77	$12.50	$13.08	$0.00	$53.35
4	80	$31.74	$12.50	$13.92	$0.00	$58.16

Notes:
Steps are 1 year

Apprentice to Journeyworker Ratio:1:4

IRONWORKER/WELDER *IRONWORKERS LOCAL 7 (SPRINGFIELD AREA)*	03/16/2019	$34.20	$8.00	$20.75	$0.00	$62.95
	09/16/2019	$35.10	$8.00	$20.75	$0.00	$63.85
	03/16/2020	$35.95	$8.00	$20.75	$0.00	$64.70
	09/16/2020	$36.85	$8.00	$20.75	$0.00	$65.60
	03/16/2021	$37.70	$8.00	$20.75	$0.00	$66.45

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate

Apprentice - *IRONWORKER - Local 7 Springfield*

Effective Date - 03/16/2019

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	60	$20.52	$8.00	$20.75	$0.00	$49.27
2	70	$23.94	$8.00	$20.75	$0.00	$52.69
3	75	$25.65	$8.00	$20.75	$0.00	$54.40
4	80	$27.36	$8.00	$20.75	$0.00	$56.11
5	85	$29.07	$8.00	$20.75	$0.00	$57.82
6	90	$30.78	$8.00	$20.75	$0.00	$59.53

Effective Date - 09/16/2019

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	60	$21.06	$8.00	$20.75	$0.00	$49.81
2	70	$24.57	$8.00	$20.75	$0.00	$53.32
3	75	$26.33	$8.00	$20.75	$0.00	$55.08
4	80	$28.08	$8.00	$20.75	$0.00	$56.83
5	85	$29.84	$8.00	$20.75	$0.00	$58.59
6	90	$31.59	$8.00	$20.75	$0.00	$60.34

Notes:

Structural 1:6; Ornamental 1:4

Apprentice to Journeyworker Ratio:

JACKHAMMER & PAVING BREAKER OPERATOR *LABORERS - ZONE 3 (BUILDING & SITE)*	12/03/2018	$31.25	$7.85	$13.91	$0.00	$53.01
	06/03/2019	$32.06	$7.85	$13.91	$0.00	$53.82
	12/02/2019	$32.87	$7.85	$13.91	$0.00	$54.63
For apprentice rates see "Apprentice- LABORER"						
LABORER *LABORERS - ZONE 3 (BUILDING & SITE)*	12/03/2018	$31.00	$7.85	$13.91	$0.00	$52.76
	06/03/2019	$31.81	$7.85	$13.91	$0.00	$53.57
	12/02/2019	$32.62	$7.85	$13.91	$0.00	$54.38

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate

Apprentice - *LABORER - Zone 3 Building & Site*

Effective Date - 12/03/2018

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	60	$18.60	$7.85	$13.91	$0.00	$40.36
2	70	$21.70	$7.85	$13.91	$0.00	$43.46
3	80	$24.80	$7.85	$13.91	$0.00	$46.56
4	90	$27.90	$7.85	$13.91	$0.00	$49.66

Effective Date - 06/03/2019

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	60	$19.09	$7.85	$13.91	$0.00	$40.85
2	70	$22.27	$7.85	$13.91	$0.00	$44.03
3	80	$25.45	$7.85	$13.91	$0.00	$47.21
4	90	$28.63	$7.85	$13.91	$0.00	$50.39

Notes:

Apprentice to Journeyworker Ratio:1:5

LABORER (HEAVY & HIGHWAY) *LABORERS - ZONE 3 (HEAVY & HIGHWAY)*	12/01/2018	$31.00	$7.85	$11.89	$0.00	$50.74
	06/01/2019	$31.79	$7.85	$11.89	$0.00	$51.53
	12/01/2019	$32.58	$7.85	$11.89	$0.00	$52.32
	06/01/2020	$33.39	$7.85	$11.89	$0.00	$53.13
	12/01/2020	$34.20	$7.85	$11.89	$0.00	$53.94
	06/01/2021	$35.04	$7.85	$11.89	$0.00	$54.78
	12/01/2021	$35.87	$7.85	$11.89	$0.00	$55.61

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate

Apprentice - *LABORER (Heavy & Highway) - Zone 3*

Effective Date - 12/01/2018

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	60	$18.60	$7.85	$11.89	$0.00	$38.34
2	70	$21.70	$7.85	$11.89	$0.00	$41.44
3	80	$24.80	$7.85	$11.89	$0.00	$44.54
4	90	$27.90	$7.85	$11.89	$0.00	$47.64

Effective Date - 06/01/2019

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	60	$19.07	$7.85	$11.89	$0.00	$38.81
2	70	$22.25	$7.85	$11.89	$0.00	$41.99
3	80	$25.43	$7.85	$11.89	$0.00	$45.17
4	90	$28.61	$7.85	$11.89	$0.00	$48.35

Notes:

Apprentice to Journeyworker Ratio:1:5

LABORER: CARPENTER TENDER *LABORERS - ZONE 3 (BUILDING & SITE)*	12/03/2018	$31.00	$7.85	$13.91	$0.00	$52.76
	06/03/2019	$31.81	$7.85	$13.91	$0.00	$53.57
	12/02/2019	$32.62	$7.85	$13.91	$0.00	$54.38
For apprentice rates see "Apprentice- LABORER"						
LABORER: CEMENT FINISHER TENDER *LABORERS - ZONE 3 (BUILDING & SITE)*	12/03/2018	$31.25	$7.85	$13.91	$0.00	$53.01
	06/03/2019	$32.06	$7.85	$13.91	$0.00	$53.82
	12/02/2019	$32.87	$7.85	$13.91	$0.00	$54.63
For apprentice rates see "Apprentice- LABORER"						
LABORER: HAZARDOUS WASTE/ASBESTOS REMOVER *LABORERS - ZONE 3 (BUILDING & SITE)*	12/01/2018	$31.10	$7.85	$13.91	$0.00	$52.86
	06/01/2019	$31.91	$7.85	$13.91	$0.00	$53.67
	12/01/2019	$32.72	$7.85	$13.91	$0.00	$54.48
For apprentice rates see "Apprentice- LABORER"						
LABORER: MASON TENDER *LABORERS - ZONE 3 (BUILDING & SITE)*	12/03/2018	$32.00	$7.85	$13.91	$0.00	$53.76
	06/03/2019	$32.81	$7.85	$13.91	$0.00	$54.57
	12/02/2019	$33.62	$7.85	$13.91	$0.00	$55.38
For apprentice rates see "Apprentice- LABORER"						
LABORER: MASON TENDER (HEAVY & HIGHWAY) *LABORERS - ZONE 3 (HEAVY & HIGHWAY)*	12/01/2018	$31.25	$7.85	$11.89	$0.00	$50.99
	06/01/2019	$32.04	$7.85	$11.89	$0.00	$51.78
	12/01/2019	$32.83	$7.85	$11.89	$0.00	$52.57
	06/01/2020	$33.64	$7.85	$11.89	$0.00	$53.38
	12/01/2020	$34.45	$7.85	$11.89	$0.00	$54.19
	06/01/2021	$35.29	$7.85	$11.89	$0.00	$55.03
	12/01/2021	$36.12	$7.85	$11.89	$0.00	$55.86
For apprentice rates see "Apprentice- LABORER (Heavy and Highway)"						
LABORER: MULTI-TRADE TENDER *LABORERS - ZONE 3 (BUILDING & SITE)*	12/03/2018	$31.00	$7.85	$13.91	$0.00	$52.76
	06/03/2019	$31.81	$7.85	$13.91	$0.00	$53.57
	12/02/2019	$32.62	$7.85	$13.91	$0.00	$54.38

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
For apprentice rates see "Apprentice- LABORER"						
LABORER: TREE REMOVER *LABORERS - ZONE 3 (BUILDING & SITE)*	12/03/2018	$31.00	$7.85	$13.91	$0.00	$52.76
	06/03/2019	$31.81	$7.85	$13.91	$0.00	$53.57
	12/02/2019	$32.62	$7.85	$13.91	$0.00	$54.38
This classification applies to all tree work associated with the removal of standing trees, and trimming and removal of branches and limbs when the work is not done for a utility company for the purpose of operation, maintenance or repair of utility company equipment. For apprentice rates see "Apprentice- LABORER"						
LASER BEAM OPERATOR *LABORERS - ZONE 3 (BUILDING & SITE)*	12/03/2018	$31.25	$7.85	$13.91	$0.00	$53.01
	06/03/2019	$32.06	$7.85	$13.91	$0.00	$53.82
	12/02/2019	$32.87	$7.85	$13.91	$0.00	$54.63
For apprentice rates see "Apprentice- LABORER"						
LASER BEAM OPERATOR (HEAVY & HIGHWAY) *LABORERS - ZONE 3 (HEAVY & HIGHWAY)*	12/01/2018	$31.25	$7.85	$11.89	$0.00	$50.99
	06/01/2019	$32.04	$7.85	$11.89	$0.00	$51.78
	12/01/2019	$32.83	$7.85	$11.89	$0.00	$52.57
	06/01/2020	$33.64	$7.85	$11.89	$0.00	$53.38
	12/01/2020	$34.45	$7.85	$11.89	$0.00	$54.19
	06/01/2021	$35.29	$7.85	$11.89	$0.00	$55.03
	12/01/2021	$36.12	$7.85	$11.89	$0.00	$55.86
For apprentice rates see "Apprentice- LABORER (Heavy and Highway)"						
MARBLE & TILE FINISHERS *BRICKLAYERS LOCAL 3 (SPR/PITT) - MARBLE & TILE*	02/01/2019	$34.67	$10.75	$18.26	$0.00	$63.68
	08/01/2019	$35.67	$10.75	$18.37	$0.00	$64.79
	02/01/2020	$36.17	$10.75	$18.37	$0.00	$65.29
	08/01/2020	$37.17	$10.75	$18.49	$0.00	$66.41
	02/01/2021	$37.67	$10.75	$18.49	$0.00	$66.91
	08/01/2021	$38.67	$10.75	$18.62	$0.00	$68.04
	02/01/2022	$39.12	$10.75	$18.62	$0.00	$68.49

Apprentice - *MARBLE-TILE FINISHER-Local 3 Marble/Tile (Spr/Pitt)*

Effective Date - 02/01/2019

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	$17.34	$10.75	$18.26	$0.00	$46.35
2	60	$20.80	$10.75	$18.26	$0.00	$49.81
3	70	$24.27	$10.75	$18.26	$0.00	$53.28
4	80	$27.74	$10.75	$18.26	$0.00	$56.75
5	90	$31.20	$10.75	$18.26	$0.00	$60.21

Effective Date - 08/01/2019

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	$17.84	$10.75	$18.37	$0.00	$46.96
2	60	$21.40	$10.75	$18.37	$0.00	$50.52
3	70	$24.97	$10.75	$18.37	$0.00	$54.09
4	80	$28.54	$10.75	$18.37	$0.00	$57.66
5	90	$32.10	$10.75	$18.37	$0.00	$61.22

Notes:

Apprentice to Journeyworker Ratio:1:5

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
MARBLE MASON/TILE LAYER(SP/PT)SeeBrick *BRICKLAYERS LOCAL 3 (SPR/PITT) - MARBLE & TILE* See "BRICK/STONE/ARTIFICIAL MASONRY(INCL.MASONRY WATERPROOFING)						
MECH. SWEEPER OPERATOR (ON CONST. SITES) *OPERATING ENGINEERS LOCAL 98* For apprentice rates see "Apprentice- OPERATING ENGINEERS"	12/01/2018	$34.79	$11.44	$13.81	$0.00	$60.04
	06/01/2019	$35.05	$11.69	$14.08	$0.00	$60.82
	12/01/2019	$35.65	$11.69	$14.35	$0.00	$61.69
MECHANIC/WELDER/BOOM TRUCK *OPERATING ENGINEERS LOCAL 98* For apprentice rates see "Apprentice- OPERATING ENGINEERS"	12/01/2018	$34.26	$11.44	$13.81	$0.00	$59.51
	06/01/2019	$34.52	$11.69	$14.08	$0.00	$60.29
	12/01/2019	$35.12	$11.69	$14.35	$0.00	$61.16
MILLWRIGHT (Zone 3) *MILLWRIGHTS LOCAL 1121 - Zone 3*	04/01/2019	$37.11	$9.90	$18.50	$0.00	$65.51

Apprentice - *MILLWRIGHT - Local 1121 Zone 3*

Effective Date - 04/01/2019

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	55	$20.41	$9.90	$5.31	$0.00	$35.62
2	65	$24.12	$9.90	$15.13	$0.00	$49.15
3	75	$27.83	$9.90	$16.10	$0.00	$53.83
4	85	$31.54	$9.90	$17.06	$0.00	$58.50

Notes:

Steps are 2,000 hours

Apprentice to Journeyworker Ratio:1:5

MORTAR MIXER *LABORERS - ZONE 3 (BUILDING & SITE)* For apprentice rates see "Apprentice- LABORER"	12/03/2018	$31.25	$7.85	$13.91	$0.00	$53.01
	06/03/2019	$32.06	$7.85	$13.91	$0.00	$53.82
	12/02/2019	$32.87	$7.85	$13.91	$0.00	$54.63
OILER *OPERATING ENGINEERS LOCAL 98* For apprentice rates see "Apprentice- OPERATING ENGINEERS"	12/01/2018	$29.95	$11.44	$13.81	$0.00	$55.20
	06/01/2019	$30.21	$11.69	$14.08	$0.00	$55.98
	12/01/2019	$30.81	$11.69	$14.35	$0.00	$56.85
OTHER POWER DRIVEN EQUIPMENT - CLASS VI *OPERATING ENGINEERS LOCAL 98* For apprentice rates see "Apprentice- OPERATING ENGINEERS"	12/01/2018	$27.97	$11.44	$13.81	$0.00	$53.22
	06/01/2019	$28.23	$11.69	$14.08	$0.00	$54.00
	12/01/2019	$28.83	$11.69	$14.35	$0.00	$54.87
PAINTER (BRIDGES/TANKS) *PAINTERS LOCAL 35 - ZONE 3*	01/01/2019	$50.36	$8.15	$20.85	$0.00	$79.36
	07/01/2019	$51.46	$8.15	$20.85	$0.00	$80.46
	01/01/2020	$52.56	$8.15	$20.85	$0.00	$81.56
	07/01/2020	$53.66	$8.15	$20.85	$0.00	$82.66
	01/01/2021	$54.76	$8.15	$20.85	$0.00	$83.76

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate

Apprentice - *PAINTER Local 35 - BRIDGES/TANKS*

Effective Date - 01/01/2019

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	$25.18	$8.15	$0.00	$0.00	$33.33
2	55	$27.70	$8.15	$5.64	$0.00	$41.49
3	60	$30.22	$8.15	$6.15	$0.00	$44.52
4	65	$32.73	$8.15	$6.66	$0.00	$47.54
5	70	$35.25	$8.15	$17.78	$0.00	$61.18
6	75	$37.77	$8.15	$18.29	$0.00	$64.21
7	80	$40.29	$8.15	$18.80	$0.00	$67.24
8	90	$45.32	$8.15	$19.83	$0.00	$73.30

Effective Date - 07/01/2019

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	$25.73	$8.15	$0.00	$0.00	$33.88
2	55	$28.30	$8.15	$5.64	$0.00	$42.09
3	60	$30.88	$8.15	$6.15	$0.00	$45.18
4	65	$33.45	$8.15	$6.66	$0.00	$48.26
5	70	$36.02	$8.15	$17.78	$0.00	$61.95
6	75	$38.60	$8.15	$18.29	$0.00	$65.04
7	80	$41.17	$8.15	$18.80	$0.00	$68.12
8	90	$46.31	$8.15	$19.83	$0.00	$74.29

Notes:
Steps are 750 hrs.

Apprentice to Journeyworker Ratio:1:1

PAINTER (SIGN, PICTORIAL & DISPLAY) *PAINTERS LOCAL 35 - ZONE 3*	06/01/2013	$25.81	$7.07	$7.05	$0.00	$39.93

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate

Apprentice - *PAINTER SIGN - Local 35 Zone 3*

Effective Date - 06/01/2013

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	$12.91	$7.07	$0.00	$0.00	$19.98
2	55	$14.20	$7.07	$2.45	$0.00	$23.72
3	60	$15.49	$7.07	$2.45	$0.00	$25.01
4	65	$16.78	$7.07	$2.45	$0.00	$26.30
5	70	$18.07	$7.07	$7.05	$0.00	$32.19
6	75	$19.36	$7.07	$7.05	$0.00	$33.48
7	80	$20.65	$7.07	$7.05	$0.00	$34.77
8	85	$21.94	$7.07	$7.05	$0.00	$36.06
9	90	$23.23	$7.07	$7.05	$0.00	$37.35

Notes:

Steps are 4 mos.

Apprentice to Journeyworker Ratio:1:1

PAINTER (SPRAY OR SANDBLAST, NEW) *	01/01/2019	$33.73	$8.15	$16.95	$0.00	$58.83
	07/01/2019	$34.83	$8.15	$16.95	$0.00	$59.93
	01/01/2020	$35.93	$8.15	$16.95	$0.00	$61.03
	07/01/2020	$37.03	$8.15	$16.95	$0.00	$62.13
	01/01/2021	$38.13	$8.15	$16.95	$0.00	$63.23

* If 30% or more of surfaces to be painted are new construction, NEW paint rate shall be used.*PAINTERS LOCAL 35 - ZONE 3*

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate

Apprentice - *PAINTER Local 35 Zone 3 - Spray/Sandblast - New*

Effective Date - 01/01/2019

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	$16.87	$8.15	$0.00	$0.00	$25.02
2	55	$18.55	$8.15	$3.49	$0.00	$30.19
3	60	$20.24	$8.15	$3.81	$0.00	$32.20
4	65	$21.92	$8.15	$4.13	$0.00	$34.20
5	70	$23.61	$8.15	$15.05	$0.00	$46.81
6	75	$25.30	$8.15	$15.36	$0.00	$48.81
7	80	$26.98	$8.15	$15.68	$0.00	$50.81
8	90	$30.36	$8.15	$16.32	$0.00	$54.83

Effective Date - 07/01/2019

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	$17.42	$8.15	$0.00	$0.00	$25.57
2	55	$19.16	$8.15	$3.49	$0.00	$30.80
3	60	$20.90	$8.15	$3.81	$0.00	$32.86
4	65	$22.64	$8.15	$4.13	$0.00	$34.92
5	70	$24.38	$8.15	$15.05	$0.00	$47.58
6	75	$26.12	$8.15	$15.36	$0.00	$49.63
7	80	$27.86	$8.15	$15.68	$0.00	$51.69
8	90	$31.35	$8.15	$16.32	$0.00	$55.82

Notes:
Steps are 750 hrs.

Apprentice to Journeyworker Ratio:1:1

PAINTER (SPRAY OR SANDBLAST, REPAINT) *PAINTERS LOCAL 35 - ZONE 3*	01/01/2019	$31.05	$8.15	$16.95	$0.00	$56.15
	07/01/2019	$32.15	$8.15	$16.95	$0.00	$57.25
	01/01/2020	$33.25	$8.15	$16.95	$0.00	$58.35
	07/01/2020	$34.35	$8.15	$16.95	$0.00	$59.45
	01/01/2021	$35.45	$8.15	$16.95	$0.00	$60.55

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate

Apprentice - *PAINTER Local 35 Zone 3 - Spray/Sandblast - Repaint*

Effective Date - 01/01/2019

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	$15.53	$8.15	$0.00	$0.00	$23.68
2	55	$17.08	$8.15	$3.49	$0.00	$28.72
3	60	$18.63	$8.15	$3.81	$0.00	$30.59
4	65	$20.18	$8.15	$4.13	$0.00	$32.46
5	70	$21.74	$8.15	$15.05	$0.00	$44.94
6	75	$23.29	$8.15	$15.36	$0.00	$46.80
7	80	$24.84	$8.15	$15.68	$0.00	$48.67
8	90	$27.95	$8.15	$16.32	$0.00	$52.42

Effective Date - 07/01/2019

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	$16.08	$8.15	$0.00	$0.00	$24.23
2	55	$17.68	$8.15	$3.49	$0.00	$29.32
3	60	$19.29	$8.15	$3.81	$0.00	$31.25
4	65	$20.90	$8.15	$4.13	$0.00	$33.18
5	70	$22.51	$8.15	$15.05	$0.00	$45.71
6	75	$24.11	$8.15	$15.36	$0.00	$47.62
7	80	$25.72	$8.15	$15.68	$0.00	$49.55
8	90	$28.94	$8.15	$16.32	$0.00	$53.41

Notes:
Steps are 750 hrs.

Apprentice to Journeyworker Ratio:1:1

PAINTER / TAPER (BRUSH, NEW) *	01/01/2019	$32.33	$8.15	$16.95	$0.00	$57.43
* If 30% or more of surfaces to be painted are new construction, NEW paint rate shall be used.*PAINTERS LOCAL 35 - ZONE 3*	07/01/2019	$34.43	$8.15	$16.95	$0.00	$59.53
	01/01/2020	$34.53	$8.15	$16.95	$0.00	$59.63
	07/01/2020	$35.63	$8.15	$16.95	$0.00	$60.73
	01/01/2021	$36.73	$8.15	$16.95	$0.00	$61.83

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate

Apprentice - *PAINTER - Local 35 Zone 3 - BRUSH NEW*

Effective Date - 01/01/2019

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	$16.17	$8.15	$0.00	$0.00	$24.32
2	55	$17.78	$8.15	$3.49	$0.00	$29.42
3	60	$19.40	$8.15	$3.81	$0.00	$31.36
4	65	$21.01	$8.15	$4.13	$0.00	$33.29
5	70	$22.63	$8.15	$15.05	$0.00	$45.83
6	75	$24.25	$8.15	$15.36	$0.00	$47.76
7	80	$25.86	$8.15	$15.68	$0.00	$49.69
8	90	$29.10	$8.15	$16.32	$0.00	$53.57

Effective Date - 07/01/2019

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	$17.22	$8.15	$0.00	$0.00	$25.37
2	55	$18.94	$8.15	$3.49	$0.00	$30.58
3	60	$20.66	$8.15	$3.81	$0.00	$32.62
4	65	$22.38	$8.15	$4.13	$0.00	$34.66
5	70	$24.10	$8.15	$15.05	$0.00	$47.30
6	75	$25.82	$8.15	$15.36	$0.00	$49.33
7	80	$27.54	$8.15	$15.68	$0.00	$51.37
8	90	$30.99	$8.15	$16.32	$0.00	$55.46

Notes:
Steps are 750 hrs.

Apprentice to Journeyworker Ratio:1:1

PAINTER / TAPER (BRUSH, REPAINT) *PAINTERS LOCAL 35 - ZONE 3*	01/01/2019	$29.65	$8.15	$16.95	$0.00	$54.75
	07/01/2019	$30.81	$8.15	$16.95	$0.00	$55.91
	01/01/2020	$31.85	$8.15	$16.95	$0.00	$56.95
	07/01/2020	$32.95	$8.15	$16.95	$0.00	$58.05
	01/01/2021	$34.05	$8.15	$16.95	$0.00	$59.15

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate

Apprentice - *PAINTER Local 35 Zone 3 - BRUSH REPAINT*

Effective Date - 01/01/2019

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	$14.83	$8.15	$0.00	$0.00	$22.98
2	55	$16.31	$8.15	$3.49	$0.00	$27.95
3	60	$17.79	$8.15	$3.81	$0.00	$29.75
4	65	$19.27	$8.15	$4.13	$0.00	$31.55
5	70	$20.76	$8.15	$15.05	$0.00	$43.96
6	75	$22.24	$8.15	$15.36	$0.00	$45.75
7	80	$23.72	$8.15	$15.68	$0.00	$47.55
8	90	$26.69	$8.15	$16.32	$0.00	$51.16

Effective Date - 07/01/2019

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	$15.41	$8.15	$0.00	$0.00	$23.56
2	55	$16.95	$8.15	$3.49	$0.00	$28.59
3	60	$18.49	$8.15	$3.81	$0.00	$30.45
4	65	$20.03	$8.15	$4.13	$0.00	$32.31
5	70	$21.57	$8.15	$15.05	$0.00	$44.77
6	75	$23.11	$8.15	$15.36	$0.00	$46.62
7	80	$24.65	$8.15	$15.68	$0.00	$48.48
8	90	$27.73	$8.15	$16.32	$0.00	$52.20

Notes:
Steps are 750 hrs.

Apprentice to Journeyworker Ratio:1:1

PAINTER TRAFFIC MARKINGS (HEAVY/HIGHWAY) *LABORERS - ZONE 3 (HEAVY & HIGHWAY)*	12/01/2018	$31.00	$7.85	$11.89	$0.00	$50.74
	06/01/2019	$31.79	$7.85	$11.89	$0.00	$51.53
	12/01/2019	$32.58	$7.85	$11.89	$0.00	$52.32
	06/01/2020	$33.39	$7.85	$11.89	$0.00	$53.13
	12/01/2020	$34.20	$7.85	$11.89	$0.00	$53.94
	06/01/2021	$35.04	$7.85	$11.89	$0.00	$54.78
	12/01/2021	$35.87	$7.85	$11.89	$0.00	$55.61
For apprentice rates see "Apprentice- LABORER (Heavy and Highway)						
PANEL & PICKUP TRUCKS DRIVER *TEAMSTERS JOINT COUNCIL NO. 10 ZONE B*	12/01/2018	$33.08	$11.91	$12.70	$0.00	$57.69
	06/01/2019	$34.08	$11.91	$12.70	$0.00	$58.69
	08/01/2019	$34.08	$12.41	$12.70	$0.00	$59.19
	12/01/2019	$34.08	$12.41	$13.72	$0.00	$60.21
	06/01/2020	$34.98	$12.41	$13.72	$0.00	$61.11
	08/01/2020	$34.98	$12.91	$13.72	$0.00	$61.61
	12/01/2020	$34.98	$12.91	$14.82	$0.00	$62.71
	06/01/2021	$35.78	$12.91	$14.82	$0.00	$63.51
	08/01/2021	$35.78	$13.41	$14.82	$0.00	$64.01
	12/01/2021	$35.78	$13.41	$16.01	$0.00	$65.20

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
PIER AND DOCK CONSTRUCTOR (UNDERPINNING AND DECK) *PILE DRIVER LOCAL 56 (ZONE 3)* For apprentice rates see "Apprentice- PILE DRIVER"	08/01/2018	$41.57	$9.90	$21.15	$0.00	$72.62
	08/01/2019	$43.79	$9.90	$21.15	$0.00	$74.84
PILE DRIVER *PILE DRIVER LOCAL 56 (ZONE 3)*	08/01/2018	$41.57	$9.90	$21.15	$0.00	$72.62
	08/01/2019	$43.79	$9.90	$21.15	$0.00	$74.84

Apprentice - *PILE DRIVER - Local 56 Zone 3*

Effective Date - 08/01/2018

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

Notes: Apprentice wages shall be no less than the following Steps;
(Same as set in Zone 1)
1$54.34/2$58.99/3$63.65/4$65.98/5$68.31/6$68.31/7$72.96/8$72.96

Apprentice to Journeyworker Ratio:1:5

PIPELAYER *LABORERS - ZONE 3 (BUILDING & SITE)* For apprentice rates see "Apprentice- LABORER"	12/03/2018	$31.25	$7.85	$13.91	$0.00	$53.01
	06/03/2019	$32.06	$7.85	$13.91	$0.00	$53.82
	12/02/2019	$32.87	$7.85	$13.91	$0.00	$54.63
PIPELAYER (HEAVY & HIGHWAY) *LABORERS - ZONE 3 (HEAVY & HIGHWAY)* For apprentice rates see "Apprentice- LABORER (Heavy and Highway)	12/01/2018	$31.25	$7.85	$11.89	$0.00	$50.99
	06/01/2019	$32.04	$7.85	$11.89	$0.00	$51.78
	12/01/2019	$32.83	$7.85	$11.89	$0.00	$52.57
	06/01/2020	$33.64	$7.85	$11.89	$0.00	$53.38
	12/01/2020	$34.45	$7.85	$11.89	$0.00	$54.19
	06/01/2021	$35.29	$7.85	$11.89	$0.00	$55.03
	12/01/2021	$36.12	$7.85	$11.89	$0.00	$55.86
PLUMBER & PIPEFITTER *PLUMBERS & PIPEFITTERS LOCAL 104*	03/17/2019	$40.21	$8.75	$16.35	$0.00	$65.31

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate

Apprentice - *PLUMBER/PIPEFITTER - Local 104*

Effective Date - 03/17/2019

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	45	$18.09	$8.75	$9.60	$0.00	$36.44
2	50	$20.11	$8.75	$9.60	$0.00	$38.46
3	55	$22.12	$8.75	$9.60	$0.00	$40.47
4	60	$24.13	$8.75	$9.60	$0.00	$42.48
5	65	$26.14	$8.75	$9.60	$0.00	$44.49
6	70	$28.15	$8.75	$9.60	$0.00	$46.50
7	75	$30.16	$8.75	$9.60	$0.00	$48.51
8	80	$32.17	$8.75	$9.60	$0.00	$50.52
9	80	$32.17	$8.75	$16.35	$0.00	$57.27
10	80	$32.17	$8.75	$16.35	$0.00	$57.27

Notes: **1:1,2:5,3:9,4:12

Apprentice to Journeyworker Ratio:**

PNEUMATIC CONTROLS (TEMP.) *PLUMBERS & PIPEFITTERS LOCAL 104*	03/17/2019	$40.21	$8.75	$16.35	$0.00	$65.31
For apprentice rates see "Apprentice- PIPEFITTER" or "PLUMBER/PIPEFITTER"						
PNEUMATIC DRILL/TOOL OPERATOR (HEAVY & HIGHWAY) *LABORERS - ZONE 3 (HEAVY & HIGHWAY)*	12/01/2018	$31.25	$7.85	$11.89	$0.00	$50.99
	06/01/2019	$32.04	$7.85	$11.89	$0.00	$51.78
	12/01/2019	$32.83	$7.85	$11.89	$0.00	$52.57
	06/01/2020	$33.64	$7.85	$11.89	$0.00	$53.38
	12/01/2020	$34.45	$7.85	$11.89	$0.00	$54.19
	06/01/2021	$35.29	$7.85	$11.89	$0.00	$55.03
	12/01/2021	$36.12	$7.85	$11.89	$0.00	$55.86
For apprentice rates see "Apprentice- LABORER (Heavy and Highway)"						
POWDERMAN & BLASTER *LABORERS - ZONE 3 (BUILDING & SITE)*	12/03/2018	$32.00	$7.85	$13.91	$0.00	$53.76
	06/03/2019	$32.81	$7.85	$13.91	$0.00	$54.57
	12/02/2019	$33.62	$7.85	$13.91	$0.00	$55.38
For apprentice rates see "Apprentice- LABORER"						
POWDERMAN & BLASTER (HEAVY & HIGHWAY) *LABORERS - ZONE 3 (HEAVY & HIGHWAY)*	12/01/2018	$32.00	$7.85	$11.89	$0.00	$51.74
	06/01/2019	$32.79	$7.85	$11.89	$0.00	$52.53
	12/01/2019	$33.58	$7.85	$11.89	$0.00	$53.32
	06/01/2020	$34.39	$7.85	$11.89	$0.00	$54.13
	12/01/2020	$35.20	$7.85	$11.89	$0.00	$54.94
	06/01/2021	$36.04	$7.85	$11.89	$0.00	$55.78
	12/01/2021	$36.87	$7.85	$11.89	$0.00	$56.61
For apprentice rates see "Apprentice- LABORER (Heavy and Highway)"						
PUMP OPERATOR (CONCRETE) *OPERATING ENGINEERS LOCAL 98*	12/01/2018	$34.79	$11.44	$13.81	$0.00	$60.04
	06/01/2019	$35.05	$11.69	$14.08	$0.00	$60.82
	12/01/2019	$35.65	$11.69	$14.35	$0.00	$61.69
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
PUMP OPERATOR (DEWATERING, OTHER) *OPERATING ENGINEERS LOCAL 98*	12/01/2018	$34.26	$11.44	$13.81	$0.00	$59.51
	06/01/2019	$34.52	$11.69	$14.08	$0.00	$60.29
	12/01/2019	$35.12	$11.69	$14.35	$0.00	$61.16
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
READY-MIX CONCRETE DRIVER *TEAMSTERS LOCAL 404*	05/01/2016	$21.01	$10.23	$9.40	$0.00	$40.64
RIDE-ON MOTORIZED BUGGY OPERATOR *LABORERS - ZONE 3 (BUILDING & SITE)*	12/03/2018	$31.25	$7.85	$13.91	$0.00	$53.01
	06/03/2019	$32.06	$7.85	$13.91	$0.00	$53.82
	12/02/2019	$32.87	$7.85	$13.91	$0.00	$54.63
For apprentice rates see "Apprentice- LABORER"						
ROLLER OPERATOR *OPERATING ENGINEERS LOCAL 98*	12/01/2018	$33.65	$11.44	$13.81	$0.00	$58.90
	06/01/2019	$33.91	$11.69	$14.08	$0.00	$59.68
	12/01/2019	$34.51	$11.69	$14.35	$0.00	$60.55
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
ROOFER (Coal tar pitch) *ROOFERS LOCAL 248*	07/16/2018	$32.31	$10.00	$15.10	$0.00	$57.41
	07/16/2019	$33.96	$10.00	$15.20	$0.00	$59.16
For apprentice rates see "Apprentice- ROOFER"						
ROOFER (Inc.Roofer Waterproofng &Roofer Damproofg) *ROOFERS LOCAL 248*	07/16/2018	$31.81	$10.00	$14.60	$0.00	$56.41
	07/16/2019	$33.46	$10.00	$14.70	$0.00	$58.16

Apprentice - *ROOFER - Local 248*

Effective Date - 07/16/2018

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	60	$19.09	$10.00	$0.00	$0.00	$29.09
2	65	$20.68	$10.00	$14.60	$0.00	$45.28
3	70	$22.27	$10.00	$14.60	$0.00	$46.87
4	75	$23.86	$10.00	$14.60	$0.00	$48.46
5	80	$25.45	$10.00	$14.60	$0.00	$50.05
6	85	$27.04	$10.00	$14.60	$0.00	$51.64
7	90	$28.63	$10.00	$14.60	$0.00	$53.23
8	95	$30.22	$10.00	$14.60	$0.00	$54.82

Notes:

Steps are 750 hrs.Roofer(Tear Off)1:1; Same as above

Apprentice to Journeyworker Ratio:1:3

ROOFER SLATE / TILE / PRECAST CONCRETE *ROOFERS LOCAL 248*	07/16/2018	$32.31	$10.00	$15.10	$0.00	$57.41
	07/16/2019	$33.96	$10.00	$15.20	$0.00	$59.16
For apprentice rates see "Apprentice- ROOFER"						
SCRAPER *OPERATING ENGINEERS LOCAL 98*	12/01/2018	$34.26	$11.44	$13.81	$0.00	$59.51
	06/01/2019	$34.52	$11.69	$14.08	$0.00	$60.29
	12/01/2019	$35.12	$11.69	$14.35	$0.00	$61.16
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
SELF-POWERED ROLLERS AND COMPACTORS (TAMPERS) *OPERATING ENGINEERS LOCAL 98*	12/01/2018	$33.65	$11.44	$13.81	$0.00	$58.90
	06/01/2019	$33.91	$11.69	$14.08	$0.00	$59.68
	12/01/2019	$34.51	$11.69	$14.35	$0.00	$60.55
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
SELF-PROPELLED POWER BROOM *OPERATING ENGINEERS LOCAL 98*	12/01/2018	$31.03	$11.44	$13.81	$0.00	$56.28
	06/01/2019	$31.29	$11.69	$14.08	$0.00	$57.06
	12/01/2019	$31.89	$11.69	$14.35	$0.00	$57.93
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
SHEETMETAL WORKER *SHEETMETAL WORKERS LOCAL 63*	01/01/2019	$34.74	$10.64	$16.22	$1.77	$63.37
	07/01/2019	$35.74	$10.64	$16.22	$1.77	$64.37
	01/01/2020	$36.99	$10.64	$16.22	$1.77	$65.62

Apprentice - *SHEET METAL WORKER - Local 63*

Effective Date - 01/01/2019

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	45	$15.63	$6.21	$4.67	$0.00	$26.51
2	50	$17.37	$6.55	$5.19	$0.00	$29.11
3	55	$19.11	$6.88	$9.33	$1.06	$36.38
4	60	$20.84	$7.22	$9.33	$1.12	$38.51
5	65	$22.58	$7.55	$9.33	$1.18	$40.64
6	70	$24.32	$7.88	$9.33	$1.25	$42.78
7	75	$26.06	$8.22	$9.33	$1.31	$44.92
8	80	$27.79	$9.30	$15.18	$1.57	$53.84
9	85	$29.53	$9.64	$15.18	$1.63	$55.98
10	90	$31.27	$9.98	$15.18	$1.69	$58.12

Effective Date - 07/01/2019

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	45	$16.08	$6.21	$4.67	$0.00	$26.96
2	50	$17.87	$6.55	$5.19	$0.00	$29.61
3	55	$19.66	$6.88	$9.33	$1.08	$36.95
4	60	$21.44	$7.22	$9.33	$1.14	$39.13
5	65	$23.23	$7.55	$9.33	$1.20	$41.31
6	70	$25.02	$7.88	$9.33	$1.27	$43.50
7	75	$26.81	$8.22	$9.33	$1.33	$45.69
8	80	$28.59	$9.30	$15.18	$1.59	$54.66
9	85	$30.38	$9.64	$15.18	$1.66	$56.86
10	90	$32.17	$9.98	$15.18	$1.72	$59.05

Notes:

Apprentice to Journeyworker Ratio:1:3

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
SPECIALIZED EARTH MOVING EQUIP < 35 TONS *TEAMSTERS JOINT COUNCIL NO. 10 ZONE B*	12/01/2018	$33.54	$11.91	$12.70	$0.00	$58.15
	06/01/2019	$34.54	$11.91	$12.70	$0.00	$59.15
	08/01/2019	$34.54	$12.41	$12.70	$0.00	$59.65
	12/01/2019	$34.54	$12.41	$13.72	$0.00	$60.67
	06/01/2020	$35.44	$12.41	$13.72	$0.00	$61.57
	08/01/2020	$35.44	$12.91	$13.72	$0.00	$62.07
	12/01/2020	$35.44	$12.91	$14.82	$0.00	$63.17
	06/01/2021	$36.24	$12.91	$14.82	$0.00	$63.97
	08/01/2021	$36.24	$13.41	$14.82	$0.00	$64.47
	12/01/2021	$36.24	$13.41	$16.01	$0.00	$65.66
SPECIALIZED EARTH MOVING EQUIP > 35 TONS *TEAMSTERS JOINT COUNCIL NO. 10 ZONE B*	12/01/2018	$33.83	$11.91	$12.70	$0.00	$58.44
	06/01/2019	$34.83	$11.91	$12.70	$0.00	$59.44
	08/01/2019	$34.83	$12.41	$12.70	$0.00	$59.94
	12/01/2019	$34.83	$12.41	$13.72	$0.00	$60.96
	06/01/2020	$35.73	$12.41	$13.72	$0.00	$61.86
	08/01/2020	$35.73	$12.91	$13.72	$0.00	$62.36
	12/01/2020	$35.73	$12.91	$14.82	$0.00	$63.46
	06/01/2021	$36.53	$12.91	$14.82	$0.00	$64.26
	08/01/2021	$36.53	$13.41	$14.82	$0.00	$64.76
	12/01/2021	$36.53	$13.41	$16.01	$0.00	$65.95
SPRINKLER FITTER *SPRINKLER FITTERS LOCAL 669*	01/01/2019	$41.51	$10.02	$13.08	$0.00	$64.61

Apprentice - *SPRINKLER FITTER - Local 669*

Effective Date - 01/01/2019

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	45	$18.68	$7.75	$0.00	$0.00	$26.43
2	50	$20.76	$7.75	$0.00	$0.00	$28.51
3	55	$22.83	$10.02	$7.25	$0.00	$40.10
4	60	$24.91	$10.02	$7.25	$0.00	$42.18
5	65	$26.98	$10.02	$7.50	$0.00	$44.50
6	70	$29.06	$10.02	$7.50	$0.00	$46.58
7	75	$31.13	$10.02	$7.50	$0.00	$48.65
8	80	$33.21	$10.02	$7.50	$0.00	$50.73
9	85	$35.28	$10.02	$7.50	$0.00	$52.80
10	90	$37.36	$10.02	$7.50	$0.00	$54.88

Notes:

Apprentice to Journeyworker Ratio:1:1

TELECOMMUNICATION TECHNICIAN *ELECTRICIANS LOCAL 7*	12/30/2018	$41.91	$10.50	$12.06	$0.00	$64.47
	06/30/2019	$42.66	$10.75	$12.33	$0.00	$65.74
	12/29/2019	$43.41	$11.00	$12.60	$0.00	$67.01

Apprentice - *TELECOMMUNICATION TECHNICIAN - Local 7*

Effective Date - 12/30/2018

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	40	$16.76	$5.70	$0.50	$0.00	$22.96
2	45	$18.86	$5.70	$0.57	$0.00	$25.13
3	50	$20.96	$10.50	$6.93	$0.00	$38.39
4	55	$23.05	$10.50	$6.99	$0.00	$40.54
5	65	$27.24	$10.50	$8.12	$0.00	$45.86
6	70	$29.34	$10.50	$9.18	$0.00	$49.02

Effective Date - 06/30/2019

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	40	$17.06	$5.85	$0.51	$0.00	$23.42
2	45	$19.20	$5.85	$0.58	$0.00	$25.63
3	50	$21.33	$10.75	$6.94	$0.00	$39.02
4	55	$23.46	$10.75	$7.00	$0.00	$41.21
5	65	$27.73	$10.75	$8.13	$0.00	$46.61
6	70	$29.86	$10.75	$9.20	$0.00	$49.81

Notes:
Steps are 800 hours

Apprentice to Journeyworker Ratio:1:1

TERRAZZO FINISHERS
BRICKLAYERS LOCAL 3 (SPR/PITT) - MARBLE & TILE

02/01/2019	$52.49	$10.75	$20.66	$0.00	$83.90
08/01/2019	$53.84	$10.75	$20.80	$0.00	$85.39
02/01/2020	$54.48	$10.75	$20.80	$0.00	$86.03
08/01/2020	$55.83	$10.75	$20.95	$0.00	$87.53
02/01/2021	$56.47	$10.75	$20.95	$0.00	$88.17
08/01/2021	$57.87	$10.75	$21.11	$0.00	$89.73
02/01/2022	$58.46	$10.75	$21.11	$0.00	$90.32

Apprentice - *TERRAZZO FINISHER-Local 3 Marble/Tile (Spr/Ptt)*

Effective Date - 02/01/2019

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	$26.25	$10.75	$20.66	$0.00	$57.66
2	60	$31.49	$10.75	$20.66	$0.00	$62.90
3	70	$36.74	$10.75	$20.66	$0.00	$68.15
4	80	$41.99	$10.75	$20.66	$0.00	$73.40
5	90	$47.24	$10.75	$20.66	$0.00	$78.65

Effective Date - 08/01/2019

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	$26.92	$10.75	$20.80	$0.00	$58.47
2	60	$32.30	$10.75	$20.80	$0.00	$63.85
3	70	$37.69	$10.75	$20.80	$0.00	$69.24
4	80	$43.07	$10.75	$20.80	$0.00	$74.62
5	90	$48.46	$10.75	$20.80	$0.00	$80.01

Notes:

Apprentice to Journeyworker Ratio:1:5

TERRAZZO MECHANIC *BRICKLAYERS LOCAL 3 (SPR/PITT) - MARBLE & TILE*	02/01/2019	$53.57	$10.75	$20.66	$0.00	$84.98
	08/01/2019	$54.92	$10.75	$20.80	$0.00	$86.47
	02/01/2020	$55.55	$10.75	$20.80	$0.00	$87.10
	08/01/2020	$56.90	$10.75	$20.95	$0.00	$88.60
	02/01/2021	$57.54	$10.75	$20.95	$0.00	$89.24
	08/01/2021	$58.94	$10.75	$21.11	$0.00	$90.80
	02/01/2022	$59.51	$10.75	$21.11	$0.00	$91.37

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate

Apprentice - *TERRAZZO MECH - Local 3 Marble/Tile (Spr/Pitt)*

Effective Date - 02/01/2019

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	$26.79	$10.75	$20.66	$0.00	$58.20
2	60	$32.14	$10.75	$20.66	$0.00	$63.55
3	70	$37.50	$10.75	$20.66	$0.00	$68.91
4	80	$42.86	$10.75	$20.66	$0.00	$74.27
5	90	$48.21	$10.75	$20.66	$0.00	$79.62

Effective Date - 08/01/2019

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	$27.46	$10.75	$20.80	$0.00	$59.01
2	60	$32.95	$10.75	$20.80	$0.00	$64.50
3	70	$38.44	$10.75	$20.80	$0.00	$69.99
4	80	$43.94	$10.75	$20.80	$0.00	$75.49
5	90	$49.43	$10.75	$20.80	$0.00	$80.98

Notes:

Apprentice to Journeyworker Ratio:1:5

TEST BORING DRILLER *LABORERS - FOUNDATION AND MARINE*	12/01/2018	$40.00	$7.85	$15.55	$0.00	$63.40
	06/01/2019	$41.00	$7.85	$15.55	$0.00	$64.40
	12/01/2019	$42.00	$7.85	$15.55	$0.00	$65.40
	06/01/2020	$42.99	$7.85	$15.55	$0.00	$66.39
	12/01/2020	$43.97	$7.85	$15.55	$0.00	$67.37
	06/01/2021	$44.99	$7.85	$15.55	$0.00	$68.39
	12/01/2021	$46.00	$7.85	$15.55	$0.00	$69.40
For apprentice rates see "Apprentice- LABORER"						
TEST BORING DRILLER HELPER *LABORERS - FOUNDATION AND MARINE*	12/01/2018	$38.72	$7.85	$15.55	$0.00	$62.12
	06/01/2019	$39.72	$7.85	$15.55	$0.00	$63.12
	12/01/2019	$40.72	$7.85	$15.55	$0.00	$64.12
	06/01/2020	$41.71	$7.85	$15.55	$0.00	$65.11
	12/01/2020	$42.69	$7.85	$15.55	$0.00	$66.09
	06/01/2021	$43.71	$7.85	$15.55	$0.00	$67.11
	12/01/2021	$44.72	$7.85	$15.55	$0.00	$68.12
For apprentice rates see "Apprentice- LABORER"						
TEST BORING LABORER *LABORERS - FOUNDATION AND MARINE*	12/01/2018	$38.60	$7.85	$15.55	$0.00	$62.00
	06/01/2019	$39.60	$7.85	$15.55	$0.00	$63.00
	12/01/2019	$40.60	$7.85	$15.55	$0.00	$64.00
	06/01/2020	$41.59	$7.85	$15.55	$0.00	$64.99
	12/01/2020	$42.57	$7.85	$15.55	$0.00	$65.97
	06/01/2021	$43.59	$7.85	$15.55	$0.00	$66.99
	12/01/2021	$44.60	$7.85	$15.55	$0.00	$68.00
For apprentice rates see "Apprentice- LABORER"						

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
TRACTORS *OPERATING ENGINEERS LOCAL 98*	12/01/2018	$33.65	$11.44	$13.81	$0.00	$58.90
	06/01/2019	$33.91	$11.69	$14.08	$0.00	$59.68
	12/01/2019	$34.51	$11.69	$14.35	$0.00	$60.55
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
TRAILERS FOR EARTH MOVING EQUIPMENT *TEAMSTERS JOINT COUNCIL NO. 10 ZONE B*	12/01/2018	$34.12	$11.91	$12.70	$0.00	$58.73
	06/01/2019	$35.12	$11.91	$12.70	$0.00	$59.73
	08/01/2019	$35.12	$12.41	$12.70	$0.00	$60.23
	12/01/2019	$35.12	$12.41	$13.72	$0.00	$61.25
	06/01/2020	$36.02	$12.41	$13.72	$0.00	$62.15
	08/01/2020	$36.02	$12.91	$13.72	$0.00	$62.65
	12/01/2020	$36.02	$12.91	$14.82	$0.00	$63.75
	06/01/2021	$36.82	$12.91	$14.82	$0.00	$64.55
	08/01/2021	$36.82	$13.41	$14.82	$0.00	$65.05
	12/01/2021	$36.82	$13.41	$16.01	$0.00	$66.24
TUNNEL WORK - COMPRESSED AIR *LABORERS (COMPRESSED AIR)*	12/01/2018	$50.88	$7.85	$15.95	$0.00	$74.68
	06/01/2019	$51.88	$7.85	$15.95	$0.00	$75.68
	12/01/2019	$52.88	$7.85	$15.95	$0.00	$76.68
	06/01/2020	$53.87	$7.85	$15.95	$0.00	$77.67
	12/01/2020	$54.85	$7.85	$15.95	$0.00	$78.65
	06/01/2021	$55.87	$7.85	$15.95	$0.00	$79.67
	12/01/2021	$56.88	$7.85	$15.95	$0.00	$80.68
For apprentice rates see "Apprentice- LABORER"						
TUNNEL WORK - COMPRESSED AIR (HAZ. WASTE) *LABORERS (COMPRESSED AIR)*	12/01/2018	$52.88	$7.85	$15.95	$0.00	$76.68
	06/01/2019	$53.88	$7.85	$15.95	$0.00	$77.68
	12/01/2019	$54.88	$7.85	$15.95	$0.00	$78.68
	06/01/2020	$55.87	$7.85	$15.95	$0.00	$79.67
	12/01/2020	$56.85	$7.85	$15.95	$0.00	$80.65
	06/01/2021	$57.87	$7.85	$15.95	$0.00	$81.67
	12/01/2021	$58.88	$7.85	$15.95	$0.00	$82.68
For apprentice rates see "Apprentice- LABORER"						
TUNNEL WORK - FREE AIR *LABORERS (FREE AIR TUNNEL)*	12/01/2018	$42.95	$7.85	$15.95	$0.00	$66.75
	06/01/2019	$43.95	$7.85	$15.95	$0.00	$67.75
	12/01/2019	$44.95	$7.85	$15.95	$0.00	$68.75
	06/01/2020	$45.94	$7.85	$15.95	$0.00	$69.74
	12/01/2020	$46.92	$7.85	$15.95	$0.00	$70.72
	06/01/2021	$47.94	$7.85	$15.95	$0.00	$71.74
	12/01/2021	$48.95	$7.85	$15.95	$0.00	$72.75
For apprentice rates see "Apprentice- LABORER"						
TUNNEL WORK - FREE AIR (HAZ. WASTE) *LABORERS (FREE AIR TUNNEL)*	12/01/2018	$44.95	$7.85	$15.95	$0.00	$68.75
	06/01/2019	$45.95	$7.85	$15.95	$0.00	$69.75
	12/01/2019	$46.95	$7.85	$15.95	$0.00	$70.75
	06/01/2020	$47.94	$7.85	$15.95	$0.00	$71.74
	12/01/2020	$48.92	$7.85	$15.95	$0.00	$72.72
	06/01/2021	$49.94	$7.85	$15.95	$0.00	$73.74
	12/01/2021	$50.95	$7.85	$15.95	$0.00	$74.75
For apprentice rates see "Apprentice- LABORER"						

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
VAC-HAUL *TEAMSTERS JOINT COUNCIL NO. 10 ZONE B*	12/01/2018	$33.54	$11.91	$12.70	$0.00	$58.15
	06/01/2019	$34.54	$11.91	$12.70	$0.00	$59.15
	08/01/2019	$34.54	$12.41	$12.70	$0.00	$59.65
	12/01/2019	$34.54	$12.41	$13.72	$0.00	$60.67
	06/01/2020	$35.44	$12.41	$13.72	$0.00	$61.57
	08/01/2020	$35.44	$12.91	$13.72	$0.00	$62.07
	12/01/2020	$35.44	$12.91	$14.82	$0.00	$63.17
	06/01/2021	$36.24	$12.91	$14.82	$0.00	$63.97
	08/01/2021	$36.24	$13.41	$14.82	$0.00	$64.47
	12/01/2021	$36.24	$13.41	$16.01	$0.00	$65.66
WAGON DRILL OPERATOR *LABORERS - ZONE 3 (BUILDING & SITE)*	12/03/2018	$31.25	$7.85	$13.91	$0.00	$53.01
	06/03/2019	$32.06	$7.85	$13.91	$0.00	$53.82
	12/02/2019	$32.87	$7.85	$13.91	$0.00	$54.63
For apprentice rates see "Apprentice- LABORER"						
WAGON DRILL OPERATOR (HEAVY & HIGHWAY) *LABORERS - ZONE 3 (HEAVY & HIGHWAY)*	12/01/2018	$31.25	$7.85	$11.89	$0.00	$50.99
	06/01/2019	$32.04	$7.85	$11.89	$0.00	$51.78
	12/01/2019	$32.83	$7.85	$11.89	$0.00	$52.57
	06/01/2020	$33.64	$7.85	$11.89	$0.00	$53.38
	12/01/2020	$34.45	$7.85	$11.89	$0.00	$54.19
	06/01/2021	$35.29	$7.85	$11.89	$0.00	$55.03
	12/01/2021	$36.12	$7.85	$11.89	$0.00	$55.86
For apprentice rates see "Apprentice- LABORER (Heavy and Highway)"						
WATER METER INSTALLER *PLUMBERS & PIPEFITTERS LOCAL 104*	03/17/2019	$40.21	$8.75	$16.35	$0.00	$65.31
For apprentice rates see "Apprentice- PLUMBER/PIPEFITTER" or "PLUMBER/GASFITTER"						
Outside Electrical - West						
EQUIPMENT OPERATOR *OUTSIDE ELECTRICAL WORKERS - WEST LOCAL 42*	09/02/2018	$42.26	$8.00	$12.50	$0.00	$62.76
	09/01/2019	$44.67	$8.00	$12.55	$0.00	$65.22
For apprentice rates see "Apprentice- LINEMAN"						
GROUNDMAN *OUTSIDE ELECTRICAL WORKERS - WEST LOCAL 42*	09/02/2018	$28.17	$8.00	$5.41	$0.00	$41.58
	09/01/2019	$30.58	$8.00	$5.48	$0.00	$44.06
For apprentice rates see "Apprentice- LINEMAN"						
GROUNDMAN / TRUCK DRIVER *OUTSIDE ELECTRICAL WORKERS - WEST LOCAL 42*	09/02/2018	$37.56	$8.00	$10.89	$0.00	$56.45
	09/01/2019	$39.97	$8.00	$10.96	$0.00	$58.93
For apprentice rates see "Apprentice- LINEMAN"						
HEAVY EQUIPMENT OPERATOR *OUTSIDE ELECTRICAL WORKERS - WEST LOCAL 42*	09/02/2018	$44.60	$8.00	$13.15	$0.00	$65.75
	09/01/2019	$47.01	$8.00	$13.22	$0.00	$68.23
For apprentice rates see "Apprentice- LINEMAN"						
JOURNEYMAN LINEMAN *OUTSIDE ELECTRICAL WORKERS - WEST LOCAL 42*	09/02/2018	$49.30	$8.00	$15.48	$0.00	$72.78
	09/01/2019	$51.71	$8.00	$15.55	$0.00	$75.26

Apprentice - *LINEMAN (Outside Electrical) - West Local 42*

Effective Date - 09/02/2018

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	60	$29.58	$8.00	$3.39	$0.00	$40.97
2	65	$32.05	$8.00	$3.46	$0.00	$43.51
3	70	$34.51	$8.00	$3.54	$0.00	$46.05
4	75	$36.98	$8.00	$5.11	$0.00	$50.09
5	80	$39.44	$8.00	$5.18	$0.00	$52.62
6	85	$41.91	$8.00	$5.26	$0.00	$55.17
7	90	$44.37	$8.00	$7.33	$0.00	$59.70

Effective Date - 09/01/2019

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	60	$31.03	$8.00	$3.43	$0.00	$42.46
2	65	$33.61	$8.00	$3.51	$0.00	$45.12
3	70	$36.20	$8.00	$3.59	$0.00	$47.79
4	75	$38.78	$8.00	$5.16	$0.00	$51.94
5	80	$41.37	$8.00	$5.24	$0.00	$54.61
6	85	$43.95	$8.00	$5.32	$0.00	$57.27
7	90	$46.54	$8.00	$7.40	$0.00	$61.94

Notes:

Apprentice to Journeyworker Ratio:1:2

TELEDATA CABLE SPLICER *OUTSIDE ELECTRICAL WORKERS - WEST LOCAL 42*	02/04/2019	$30.73	$4.70	$3.17	$0.00	$38.60
TELEDATA LINEMAN/EQUIPMENT OPERATOR *OUTSIDE ELECTRICAL WORKERS - WEST LOCAL 42*	02/04/2019	$28.93	$4.70	$3.14	$0.00	$36.77
TELEDATA WIREMAN/INSTALLER/TECHNICIAN *OUTSIDE ELECTRICAL WORKERS - WEST LOCAL 42*	02/04/2019	$28.93	$4.70	$3.14	$0.00	$36.77
TRACTOR-TRAILER DRIVER *OUTSIDE ELECTRICAL WORKERS - WEST LOCAL 42*	09/02/2018	$42.26	$8.00	$12.50	$0.00	$62.76
	09/01/2019	$44.67	$8.00	$12.55	$0.00	$65.22
TREE TRIMMER *OUTSIDE ELECTRICAL WORKERS - WEST LOCAL 42*	01/31/2016	$18.51	$3.55	$0.00	$0.00	$22.06

This classification applies only to tree work done: (a) for a utility company, R.E.A. cooperative, or railroad or coal mining company, and (b) for the purpose of operating, maintaining, or repairing the utility company's equipment, and (c) by a person who is using hand or mechanical cutting methods and is not on the ground. This classification does not apply to wholesale tree removal.

TREE TRIMMER GROUNDMAN *OUTSIDE ELECTRICAL WORKERS - WEST LOCAL 42*	01/31/2016	$16.32	$3.55	$0.00	$0.00	$19.87

This classification applies only to tree work done: (a) for a utility company, R.E.A. cooperative, or railroad or coal mining company, and (b) for the purpose of operating, maintaining, or repairing the utility company's equipment, and (c) by a person who is using hand or mechanical cutting methods and is on the ground. This classification does not apply to wholesale tree removal.

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate

Additional Apprentice Information:

Minimum wage rates for apprentices employed on public works projects are listed above as a percentage of the pre-determined hourly wage rate established by the Commissioner under the provisions of the M.G.L. c. 149, ss. 26-27D. Apprentice ratios are established by the Division of Apprenticeship Training pursuant to M.G.L. c. 23, ss. 11E-11L.

All apprentices must be registered with the Division of Apprenticeship Training in accordance with M.G.L. c. 23, ss. 11E-11L.

All steps are six months (1000 hours.)
Ratios are expressed in allowable number of apprentices to journeymen or fraction thereof, unless otherwise specified.

** Multiple ratios are listed in the comment field.
*** APP to JM; 1:1, 2:2, 2:3, 3:4, 4:4, 4:5, 4:6, 5:7, 6:7, 6:8, 6:9, 7:10, 8:10, 8:11, 8:12, 9:13, 10:13, 10:14, etc.
**** APP to JM; 1:1, 1:2, 2:3, 2:4, 3:5, 4:6, 4:7, 5:8, 6:9, 6:10, 7:11, 8:12, 8:13, 9:14, 10:15, 10:16, etc.

Section 01.11.00
SUMMARY OF WORK

1.1 GENERAL PROVISIONS

A. The Work under the Contract consists of:
   1. All Work either shown on the Drawings or included in the Specifications unless specifically indicated as not to be done.
   2. Site work, construction of a new 28,850 SF pre-engineered building that accommodates administrative space, vehicle repair bays, vehicle storage bays, truck wash, shops and storage. In addition, the work includes construction of a new 50' x 90' fabric salt storage structure.

      In general, the Work will include site work and utilities (soils, water, sewer, drains, infiltration system, paving, landscaping); new concrete foundations and pre-engineered steel superstructure; masonry veneer and metal panel envelope; fiberglass windows; interior finishes (ceramic tile, epoxy flooring, suspended ceilings, millwork, painting, doors & hardware, toilet accessories, signage); 10-ton bridge crane; fire protection and alarm systems; plumbing; HVAC (radiant floor heat), tele/data and electrical (including solar panels).

B. In addition, the Work under the Contract includes:
   1. Work outside the Project Site as called for in the Contract Documents and as required for the performance of the Work.
   2. The restoration of any items damaged or destroyed by encroaching upon areas outside the Project Site.
   3. Providing and restoring, where appropriate, all temporary facilities.

C. The Contractor's attention is directed to Article 3.3 of the General Conditions.

D. The site/building and adjacent site/buildings will be occupied during construction. The Contractor shall take all necessary precautions to ensure the public safety and convenience of the occupants during construction.

E. The Work must be completed in a continuous uninterrupted operation. The Contractor must use sufficient personnel and adequate equipment to complete all the necessary Work requirements within a minimum period of time.

F. In accordance with Articles 3.3.7 and 3.3.8 of the General Conditions and unless specifically authorized in writing by the Awarding Authority, the Work must be conducted between the hours of 7:00 a.m. and 5:00 p.m. on Monday through Friday. No work is to be done on holidays, Saturdays or Sundays or days that the Awarding Authority is closed other than for emergencies.

G. The Contractor is responsible for the security of partially completed Work until the Final Acceptance of Work by the Awarding Authority.

I. Only materials and/or equipment intended and necessary for immediate use shall be brought into the Project area. At the end of each work day and at the completion of each phase of Work, equipment and leftover or unused materials shall be removed from the area.

J. Smoking is not permitted on site or in buildings/facilities.

1.2 TIME OF COMPLETION

A. In accordance with Article 8 of the General Conditions, the Work shall start as stated in the Notice to Proceed and shall be completed within **300** consecutive calendar days.

1.3 COORDINATION

A. In accordance with Article 8.4.1 of the General Conditions, the Contractor shall submit for approval to the Prime Designer a detailed operational plan and construction schedule showing the sequence of operations prior to commencement of any Work at the site. The Awarding Authority must approve any changes to the accepted operational plan and construction schedule. The Awarding Authority shall assist the Contractor to perform the Work in accordance with the approved operational plan by removing obstructions that may be in the Contractor' way, upon proper notice from the Contractor.

B. In accordance with Article 3.4, the Contractor must retain a competent full-time superintendent, satisfactory to the Awarding Authority, on site during all Work in progress. This representative shall not be changed, except with the consent of the Awarding Authority. The representative shall be in full charge of the Work and all instructions given to this person by the Prime Designer shall be binding.

C. In accordance with Article 3.22.2 of the General Conditions, the Contractor must supply to the Awarding Authority the telephone number of a responsible person who may be contacted during non-work-hours for emergencies on the Project.

D. If access of Work is required in occupied areas outside the Project area, the Contractor's Superintendent and an Awarding Authority's representative shall conduct a pre-work inspection of the area to document the existing conditions. Special attention should be paid to areas where the new work will meet existing conditions.

E. Services Shutdowns: The Contractor's attention is called to the fact that the continuous operation of services for this building/site is mandatory. If the building is to be left without heat, hot water, domestic water, electricity, gas, sanitary facilities or any other services for more than an eight hours period, the Contractor shall submit a letter and obtain written approval from the Awarding Authority

before proceeding. If the Awarding Authority will not allow this shutdown, but wants a temporary means of supplying said services, the Contractor shall supply all labor, materials or whatever may be required to supply said temporary services at no extra cost to the Awarding Authority and in accordance with the state and local regulations on health and safety. See the supplemental General Conditions for the specific procedures to coordinate the utility shutdowns.

1.4 WORK UNDER SEPARATE CONTRACT

A. - NOT USED

B. - NOT USED

1.5 ITEMS FURNISHED BY OWNER

A. - NOT USED

B. - NOT USED

C. The Contractor shall include in the Contract Sum the cost of unloading, uncreating, and permanently installing the above listed items; also removal and proper disposal off the Project Site of all crating and packing materials.

1.6 SAMPLE WORK - NOT USED

1.7 RETAINED ITEMS - NOT USED

1.8 PHASING

A. - NOT USED

B. At the pre-construction meeting, the Contractor shall submit a construction schedule showing the proposed schedule for the Work as noted on the phasing plan drawings. The Awarding Authority and Prime Designer will work with the Contractor to ensure proper coordination.

C. The building/site will be occupied during the construction until final acceptance of the Work. Safety is of paramount importance on this Project. The Contractor must take measure to maintain a clean work site and to secure the site in a safe manner for the public, tenants and property at all times.

1.9 DISRUPTIVE WORK and IRREGULAR WORK HOURS

A. Awarding Authority's Operations Take Precedence: At no increase in the Contract Amount, the Contractor shall adjust its Work schedule to accommodate the needs of the Awarding Authority, including, but not limited to, any plumbing

shutdowns for “tie-ins”, plumbing “drain-downs”, asbestos abatement, irregular work hours, etc.

B. - NOT USED

1.10 SPECIAL REQUIREMENTS - NOT USED

END OF SECTION

Section 01.22.00
UNIT PRICES

1.1 GENERAL PROVISIONS

A. The Unit Prices for items set forth in the Schedule of Unit Prices shall be used to determine adjustments to the Contract Sum when changes in the Work involving said items are made in accordance with Article 7 of the General Conditions and other sections of the Contract Documents.

B. Definition: A unit price is the payment amount assigned to the Contractor in the Contract Document for a per unit of measurement for materials or services added to or deducted from the Contract Sum by appropriate modification. If unit prices are specified, the Contract will be modified for quantities above or below the designated quantity in the Base Bid.

1.2 PRE-DETERMINED UNIT PRICES

A. Unit Prices listed under ADDITIONS have been computed to include net cost plus overhead, profit, and bond and all other charges required to complete the work item.

B. Unit Prices listed under DEDUCTIONS have been computed at the net cost alone.

C. Unit Prices net cost include the cost of all labor, materials, equipment, disposal, and all other costs required to complete the work item.

D. Unit Prices shall apply until the date of Contract Completion established at the time of the Notice to Proceed. If the date of Contract Completion has been modified by Change Order, Unit Prices may be adjusted at the discretion of the Awarding Authority.

E. Unit Prices for excavation include the costs of sheeting and bracing, pumping and dewatering, and all other related costs. Excavation quantities shall be measured as compacted in place at maximum dry density.

F. Materials, methods of installation, and definitions of terms set forth under the various Unit Price items in the Schedule of Unit Prices shall be as indicated in the Contract Documents.

1.3 APPLICABILITY OF UNIT PRICES

A. The payment lines shall be as indicated in the Contract Documents.

B. Prior to commencing removal or placement of materials set forth in the Schedule

of Unit Prices, the Contractor shall notify the Awarding Authority and the Prime Designer in sufficient time (not less than 24 hours in advance) to permit proper measurements to be taken on behalf of the Awarding Authority. Only quantities which have been approved in writing by the Prime Designer will be considered in the determination of adjustments to the Contract Sum.

1. The Awarding Authority reserves the right to monitor the unit price Work being performed. If the Awarding Authority elects to monitor the Work, the Contractor shall not commence the unit price Work until the designated monitor is present.
2. In order to be considered for payment, the Contractor shall document in writing all unit price Work performed to include the trade, type, quantity and location. The unit price Work performed shall be documented at the completion of each workday, verified and signed by the Contractor's superintendent.
3. At the Awarding Authority's expense and if quantities of unit price Work are in dispute, the Awarding Authority may elect to retain an independent party to verify the Contractor's measurement of unit price Work performed.

C. Performance of Work which is not required under the Contract Documents or which is not authorized by Change Order, whether or not such Work item is set forth hereunder as a Unit Price item, shall not be considered cause for extra payment. The Contractor will be held fully responsible for such unauthorized work, including the performance of all corrective measures required by the Prime Designer.

1.4 SCHEDULE OF UNIT PRICES

The following unit prices are in effect:

- Unit Price #1 Bi Direction Amplification System (BDA)
  Base Bid Quantity: 0 EA
  Add: $32000 / EA
  Deduct: $0 / EA
  Description: Provide and install a complete BDA system for the building as specified under Section 26 00 01.

END OF SECTION

Section 01.23.00
ALTERNATES

1.1 SCOPE

A. This Section lists the Alternates which appear in the Contract Documents. Consult the individual sections of the detailed requirements of each Alternate.

B. Bid prices for each Alternate shall include overhead, profit, and all other expenses incidental to the Work under each Alternate.

C. The Contractor and Subcontractors shall be responsible for examining the scope of each Alternate generally defined herein and for recognizing modifications to the Work caused by the Alternates and including the cost thereof in the bid price.

D. The Contractor's alternate amount shall include the net change in cost to perform all of the work described in the Alternate.

1.2 LIST OF ALTERNATES

ALTERNATE NO 1
Provide all labor and material to install the 10-ton bridge crane as shown on drawing A-101, A-102 and A-405. The associated work includes the electrical power to the crane. The Base Bid work includes installation of the crane support columns, running beams and associated foundations.
Performance Period: Unchanged

ALTERNATE NO 2
Provide all labor and material to install radiant floor heat in the Shop area #117. Base bid includes HVAC system as shown on drawing H-101.
Performance Period: Unchanged

ALTERNATE NO 3
Provide all labor and material to install radiant floor heat in the Vehicle Storage area #123. Base bid includes unit heaters as shown on drawing H-102.
Performance Period: Unchanged

ALTERNATE NO 4
Provide all labor and material to install the 50'x90' fabric Salt Shed as shown on drawings A-105 and associated electrical. Base Bid will only include grading the area flat for future installation.
Performance Period: Unchanged

END OF SECTION

Section 01.33.00
SUBMITTAL PROCEDURES

1.1 RELATED DOCUMENTS

A. This Section supplements Articles 3.6.3, 3.7, 3.8, 3.15 and 4.3.5 of the General Conditions.

B. Consult the individual sections of the specifications for the specific submittals required under those sections and for further details and descriptions of the requirements.

1.2 GENERAL PROCEDURES FOR SUBMITTALS

A. Timeliness - The Contractor shall transmit all submittals within **30 calendar days** after the Notice to Proceed for Projects with a performance period of 60 calendar days or greater and within **14 calendar days** for Projects with a performance period less than 60 calendar days as specified Section 01.11.00 paragraph 1.3. In addition, the Contractor shall transmit each submittal to the Prime Designer in advance of performing related Work or other applicable activities so that the installation is not delayed by processing times, including disapproval and re-submittal (if required), coordination with other submittals, testing, purchasing, fabrication, delivery, and similar sequenced activities. The Prime Designer shall review the submittals in accordance with Article 4.3.5 of the General Conditions. No extension of time will be authorized because of the Contractor's failure to transmit submittals to the Prime Designer in advance of the Work.

B. Sequence - The Contractor shall transmit each submittal in a sequence which will not result in the Prime Designer's approval having to be later modified or rescinded by reason of subsequent submittals which should have been processed earlier or concurrently for coordination.

C. Contractor's Review and Approval - Only submittals received from and bearing the stamp of approval of the Contractor will be considered for review by the Prime Designer. Submittals shall be accompanied by a transmittal notice stating name of Project, date of submittal, "To", "From" (Contractor, Subcontractor, Installer, Manufacturer, Supplier), Specification Section, or Drawing No. to which the submittal refers, purpose (first submittal, re-submittal), description, remarks, distribution record, and signature of transmitter.

D. Contractor's Submittal Log - On a weekly basis, the Contractor shall prepare and submit a log documenting the status (open or returned) of each submittal and the date forwarded to the Prime Designer for review. On "open" submittals, the Contractor shall identify if the submittal is a "priority" due to the lead time and potential impact on the construction schedule. On submittals returned by the Prime Designer, the Contractor shall document the date returned and the action taken by the Prime Designer.

E. Prime Designer's Action - The Prime Designer will review the Contractor's submittals and return them with one of the following actions recorded thereon by appropriate markings:
   1. Final Unrestricted Release: Where marked "Approved" the Work covered by the submittal may proceed provided it complies with the requirements of the Contract Documents.
   2. Final-But-Restricted Release: When marked "Approved as Noted" the Work may proceed provided it complies with the Prime Designer's notations or corrections on the submittal and complies with the requirements of the Contract Documents. Acceptance of the Work will depend on these compliances.
   3. Returned for Re-submittal: When marked "Revise and Resubmit" or "Disapproved" the Work covered by the submittal (such as purchasing, fabrication, delivery, or other activity) should not proceed. The submittal should be revised or a new submittal resubmitted without delay, in accordance with the Prime Designer's notations stating the reasons for returning the submittal.
   4. No Action Required: When marked "No Action Required", the Work covered by the submittal is for information only and does not require review or action by the Prime Designer.

F. Processing - All costs for printing, preparing, packaging, submitting, resubmitting, and mailing/delivering submittals required by this Contract shall be included in the Contract Sum.
   1. The Contractor shall electronically deliver (in PDF format) submittals to the Prime Designer and copy the Awarding Authority and Owner's Project Manager (OPM) if applicable. Submittals forwarded directly from subcontractors, manufacturers or vendors or directly to the Prime Designer's consultants will be returned without action. The Prime Designer will be responsible for distribution of the submittals to the consultants for review and action.
   2. The Contractor shall be responsible for preparing a "hard copy" of the submittal when requested by the Prime Designer and/or Awarding Authority in writing. The Contractor will be responsible for converting the hard copy submittal, with the Prime Designer's actions, into an electronic format (in PDF format) as part of the final close-out documents.
   3. Upon review by the Prime Designer, the consultants, the Awarding Authority and/or OPM, the Prime Designer will return an electronic copy of the

submittal annotating the action taken.

4. The Contractor is responsible for distribution of the reviewed submittals to the Contractor's personnel and subcontractors.
5. The Contractor shall retain an electronic copy of each submittal and the action taken by the Prime Designer for submission as "record submittals" at the close-out of the Project in accordance with Section 01.77.00.

G. Substitutions - Prepare and process all substitutions in accordance with Article 3.6.3 of the General Conditions.

1.3 SUBMISSION OF PRODUCT DATA

A. The Contractor shall submit an electronic copy (PDF format) of Product Data to the Prime Designer. The electronic copy shall be a single file for each submittal (multiple files will not be accepted). All such data shall be specific and identification of material or equipment submitted shall be clearly marked. Data of a general nature will not be accepted.

B. Product Data shall be accompanied by a transmittal notice. The Contractor's stamp of approval shall appear on the printed information itself, in a location which will not impair legibility.

C. Product Data returned by the Prime Designer as "Disapproved" shall be resubmitted in an electronic copy until the Prime Designer's approval is obtained.

D. When the Product Data are acceptable, the Prime Designer will mark them "Approved" or "Approved as Corrected" and transmit an electronic copy to the Contractor. The Contractor shall provide and distribute additional copies as may be required to complete the Work.

E. The Contractor shall maintain one full set of approved and original, Product Data at the Site.

1.4 SUBMISSION OF SHOP DRAWINGS

A. Shop Drawings shall be complete, giving all information necessary or requested in the individual section of the specifications. They shall also show adjoining Work and details of connection thereto.

B. Shop Drawings shall be for whole systems. Partial submissions will not be accepted.

C. The Prime Designer reserves the right to review and approve shop drawings only after approval of related product data and samples.

D. Shop drawings shall be properly identified and contain the name of the project, name of the firm submitting the shop drawings, shop drawing number, date of shop drawings and revisions, Contractor's stamp of approval and sufficient spaces near the title block for the Prime Designer's stamp.

E. The Contractor shall submit an electronic copy (PDF format) of Shop Drawings to the Prime Designer. The electronic copy shall be a single file for each submittal (multiple files will not be accepted). Each submittal shall be accompanied by a transmittal notice.

F. When the Prime Designer returns the electronic copy marked "Revise and Resubmit" or "Disapproved", the Contractor shall correct the original drawing or prepare a new drawing and resubmit the electronic copy to the Prime Designer for approval. This procedure shall be repeated until the Prime Designer's approval is obtained.

G. When the Prime Designer returns an electronic copy marked "Approved" or "Approved as Corrected", the Contractor shall provide and distribute copies for all Contractor and Subcontractors use, and in addition submit, within 10 calendar days after approval, one (1) print to the Prime Designer.

H. The Contractor shall maintain one full set of approved shop drawings at the Site.

1.5 COORDINATION DRAWINGS

A. The Contractor shall be responsible for the coordination of all mechanical and electrical Work with architectural requirements including ceiling layouts. Prior to the commencement of the Work, the Contractor shall instruct the various Subcontractors to prepare and submit the mechanical, fire protection, plumbing and electrical Coordination Drawings for review by the Prime Designer. Each Subcontractor is responsible for the actual preparation of the Coordination Drawings for their trade. The Contractor is responsible for the coordination of the Subcontractors efforts and the final compilation of the Coordination Drawings.

B. The Coordination Drawings shall include the following information.:
   1. The Coordination Drawings shall indicate the necessary offsets for all ductwork, piping, conduit, and other items to clear the work of all other trades, and structure, and to maintain the required ceiling height, ceiling layout and partition layout.
   2. The Coordination drawings shall be at a scale not less than 1/4" = 1'-0".

Congested areas and sections through shafts shall be at a scale not less than 3/8" = 1'-0".

3. The Coordination Drawings shall show the reflected ceiling plan in the background.
4. HEATING AND VENTILATING Subcontractor (if applicable) shall prepare and submit to the Contractor original Drawings showing all ductwork, hot water and other heating lines, based on approved Sheet Metal Fabrication Drawings and related mechanical submittals.
5. The PLUMBING Subcontractor (if applicable) shall prepare and submit to the Contractor original Drawings showing all equipment and plumbing lines.
6. The FIRE PROTECTION Subcontractor (if applicable) shall prepare and submit to the Contractor original Drawings showing all equipment, heads and piping lines.
7. The ELECTRICAL Subcontractor (if applicable) shall prepare and submit to the Contractor original Drawings showing all equipment and conduit lines.
8. The Contractor shall compile the Coordination Drawings of all the trades. In addition, the Contractor shall show locations and sizes of all access panels for all trades on Coordination Drawings.
9. The final Coordination Drawings shall bear the signature of all subcontractors involved preparing the drawings and indicate that all space conditions have been satisfactorily resolved. In addition, the Drawings shall bear the Contractor's stamp bearing the notation "Drawings Have Been Checked and Coordinated with all Trades".

C. Processing and submitting the Coordination Drawings.
1. The Coordination Drawings are for the Contractor's and Prime Designer's use during construction and shall not be construed as replacing any Shop, "As-Built", or other Record Drawings required elsewhere in these Contract Documents.
2. The Contractor shall resolve conflicts and submit in PDF format to the Prime Designer for review. If any space conflicts cannot be resolved by the Contractor, the Contractor shall notify the Prime Designer in writing within seven (7) calendar days.
3. The Contractor shall submit a complete and final set of Coordination Drawings for record purposes in colorized PDF format and three (3) color hard copy prints. The Prime Designer's review of Coordination Drawings shall not relieve the Contractor from overall responsibility for coordination of all Work performed pursuant to the Contract or from any other requirements of the Contract.

1.6 SUBMISSION OF SAMPLES

A. Unless otherwise specified in the individual section, the Contractor shall submit two specimens of each sample.

B. Samples shall be of adequate size to permit proper evaluation of materials. Where variations in color or in other characteristics are to be expected, samples shall show the maximum range of variation. Materials exceeding the variation of approved samples will not be approved on the Work.

C. Samples of items of interior finishes shall be submitted all at once to permit a coordinated selection of colors and finishes.

D. Samples that can be conveniently mailed shall be sent directly to the Prime Designer, accompanied by a transmittal notice. All transmittals shall be stamped with the Contractor's approval stamp of the material submitted. In addition, the Contractor shall forward an electronic copy of the transmittal to the Prime Designer.

E. All other samples shall be delivered at the field office with sample identification tag attached and properly filled in. Transmittal notice of samples so delivered with the Contractor's stamp of approval shall be mailed to the Prime Designer.

F. If a sample is rejected by the Prime Designer, a new sample shall be resubmitted in the specified manner. This procedure shall be repeated until the Prime Designer approves the sample.

G. Samples will not be returned unless return is requested at the time of submission. The right is reserved to require submission of samples whether or not particular mention is made in the specifications, at no additional cost to the Awarding Authority.

END OF SECTION

Section 01.33.01
SUBSTITUTION REQUEST FORM

Awarding Authority
Town of Montague
Montague Town Hall, One Avenue A
Turners Falls, MA 01376

New DPW Facility

To: HELENE KARL Architects, Inc.
61 Skyfields Drive
Groton, MA 01450

Date: _____

We hereby submit for your consideration the following product as a substitution for the item specified for the above referenced project:

Drawing Number: _____ Drawing Title: _____

Specification Section: _____ Section Title:_____

Paragraph: _____ Specified Item: _____

Proposed Substitution: _____

Attach complete information on changes to Drawings and Specifications, including related work on other Drawings and under other Sections of the Specifications necessary for the proper installation of the proposed substitution, including proper coordination and finishing.

Submit with request complete Product Data, samples and other data necessary to substantiate that the proposed item is equal to or exceeds the specified item in all respects. Include a comparison chart showing material features and properties of the specified item and the proposed substitute, paying particular attention to requirements specifically mentioned in the Specifications or shown on the Drawings, and guarantee/warranty information. Clearly mark manufacturer's literature to indicate equality in performance. In the case of operating equipment or systems, provide information as to servicing and maintenance requirements, and anticipated service life in the indicated application.

Fill in the blanks below (attach additional sheets as necessary):

A. Does the substitute affect dimensions shown on the Drawings: ☐ Yes ☐ No
(if yes, clearly indicate changes on enclosures)

B. Will the undersigned pay for changes to the building design, including architectural / engineering detailing costs caused by the requested substitution: ☐ Yes ☐ No
(if no, please explain)

C. What effect does the substitution have on other Contracts or other trades?

D. What effect does the substitution have on construction schedule?

E. Manufacturer's warranties of the specified and proposed items are:
☐ Same ☐ Different Explain:

F. Itemized comparison of specified item with proposed substitute. Attach a detailed explanation.

G. This substitution will amount to a credit or extra cost to the Awarding Authority of:

☐ No Cost Change

☐ Credit ($ _____) Dollars

☐ Add $ _____ Dollars

Notes:

1. This submission shall be in accordance with Article 3.6.3.4 of the General Conditions.

2. The Awarding Authority's acceptance of any substitution will not change the Contract Price or Schedule, unless the Awarding Authority and Contractor execute a Change Order in accordance with the terms and provisions of the Contract Documents.

3. Refer to Section 01.33.00 – SUBMITTAL PROCEDURES, for additional requirements for the submittal and processing of substitution requests.

Company: _____

Submitted By: _____
Print Name / Title

Submitted By: _____
Signature / Date

END OF FORM

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Section 01.50.00
TEMPORARY FACILITIES

1.1 GENERAL REQUIREMENTS

A. The Contractor shall be responsible for providing and maintaining all temporary facilities until Substantial Completion. Removal of such prior to Substantial Completion must be with the concurrence of the Prime Designer. The Contractor bears full responsibility for re-providing any facility removed prior to Substantial Completion.

B. Removal of all temporary facilities shall be a condition precedent to Substantial Completion unless directed otherwise by the Prime Designer or specifically noted in the specifications.

C. The Contractor must comply with all safety laws and regulations of the Commonwealth of Massachusetts, the United States Government, and local government agencies applicable to Work under this contract. The Contractor's attention is directed to the Commonwealth of Massachusetts, Department of Labor and Workforce Development Regulations.

1.2 FIELD OFFICES

A. The Contractor shall provide a suitable field office at the site for use by the Contractor's personnel. The Contractor shall include any general services at the Site as specified herein and as required for proper and expeditious prosecution of Work. Unless otherwise specified, the Contractor shall pay for all temporary facilities and general services until Final Acceptance of the Work and shall remove same at completion of the Work.

B. All such services and facilities shall comply with applicable Federal, State and local regulations.

C. The Contractor shall make all connections to existing services and sources of supply, shall provide all necessary installations, labor, materials and equipment, in a manner subject to the approval by the Prime Designer and the Awarding Authority, shall remove temporary installations and conditions when no longer required, and shall restore the services and sources of supply to proper operating condition.

D. The Contractor shall be liable for discontinuance of any temporary service prior to the completion of any portions of the Work.

E. Should a change in location of any temporary facility or equipment be necessary for the Work to progress properly, the Contractor shall remove and relocate such facility as required without additional cost to the Awarding Authority.

F. Project Representative's Field Office: In addition to the Contractor's field office, the Contractor shall provide a separate field office of not less than 190 square feet in area for the use by the Awarding Authority's Project Representative(s). This office shall have one larger area for conferences, 1 smaller office for the Project Representative, 1 wardrobe closet, and be equipped with electricity, heat and lights.

The Contractor shall furnish the Project Representative's field office with the following:

1 - Double desk with chair, 7 ft. wide
1 - 4 Drawer, steel file cabinet with lock and key
1 - Plan table, at least 3 ft. by 7 ft.
1 - Plan rack
2 - Overhead shelves 7 ft. long
8 - Chairs and conference table
1 - Working Air Conditoner
1 - Computer with Microsoft Word and Excel, Adobe and email access
1 - Plain Paper Fax Machine
1 - First class outdoor thermometer
1 - Waste Basket
1 - Mobile Phone Device

1. The offices shall be set in a location approved by the Awarding Authority, and shall be maintained by the Contractor in a clean and orderly condition.
2. The Contractor shall provide and pay for High Speed Internet access and router via DSL, Broadband, Cable, or equal with unlimited Internet access to the field office.
3. After enclosed and heated building space becomes available, the Contractor may move the field office (including telephones) into the building. The space within the building, so used, shall be subject to approval by the Awarding Authority.

1.3 TEMPORARY TELEPHONES

A. The Contractor shall provide a separate service for the use of the Contractor's authorized personnel and Subcontractors.

C. The Contractor shall provide a separate telephone service for the fax machine specified in Paragraph 2B.

D. The Contractor shall pay for the installation and removal of the foregoing temporary telephones and for all calls and charges in connection therewith.

1.4 TEMPORARY TOILETS

A. The Contractor shall provide and service an adequate number of toilet booths with chemical type toilets. The Contractor shall pay for the installation, service and removal of the chemical type toilets.

B. The toilets shall be erected in a location approved by the Prime Designer and shall be maintained by the Contractor in a clean and orderly condition in compliance with all local and state health requirements.

C. When the existing and/or new permanent sanitary system/facilities are in operating condition, the Contractor may request in writing to the Awarding Authority the use of the permanent sanitary system/facilities, provided that the Contractor;
   1. assumes full responsibility for the used portions of the sanitary system, and
   2. pays all costs for operation, maintenance, cleaning, and restoring to original condition of used portions.

D. If the Awarding Authority determines that the Contractor is not properly maintaining the permanent sanitary system/facilities, the Awarding Authority may prohibit the use of the permanent sanitary system/facilities and direct the Contractor to provide chemical type toilets.

1.5 TEMPORARY STRUCTURES AND MATERIAL HANDLING

A. The Contractor shall provide such storage sheds, temporary buildings, or trailers as required for the performance of the Contract. Subcontractors shall provide their own temporary buildings and trailers.

B. Materials shall be handled, stored, installed, cleaned and protected in accordance with the best practice in the industry and, except where otherwise specified in the Contract Documents, in accordance with manufacturer's specifications and directions.

C. The Contractor must obtain the written permission of the Awarding Authority for the use of any storage facilities available on Site, but the Awarding Authority assumes no responsibility for articles stored.

1.6 TEMPORARY STAGING, STAIRS, CHUTES

A. Except as otherwise specified, the Contractor shall furnish, install, maintain in safe condition, and remove all scaffolds, staging, and planking over 8 ft. in

height, as required for the use of all trades for proper execution of the Work.

B. The Contractor shall furnish, install, maintain in safe condition and remove all temporary ramps, stairs, ladders and similar items as required for the use of all trades for the proper execution of the Work.

C. Permanent stairs shall be erected as soon as possible, for which the Contractor shall provide temporary protective treads, risers, handrails and shaft protection.

D. The Contractor shall furnish, install, maintain, and remove covered chutes from openings in the exterior walls of upper floors. Such chutes shall be in convenient locations and permit disposal of rubbish directly into trucks or disposal units.

E. Debris shall not be allowed to fall freely from upper levels of the building. Materials shall not be dropped from open windows.

1.7 HOISTING FACILITIES

A. Except as otherwise specified, the Contractor shall provide, operate and remove material hoists, cranes, and other hoisting as required for the performance of the Work by all trades. All such hoisting service shall be without cost to the Subcontractors.

B. Construction, maintenance and operation of material hoists shall conform to applicable requirements of the "Standard Safety Code for Building Construction", ANSI, to Association of General Contractor's "Manual" requirements and to State and local regulations.

1.8 TEMPORARY USE OF ELEVATOR - NOT AVAILABLE

1.9 TEMPORARY WATER

A. The Contractor shall make arrangements with the local water department for obtaining temporary water connections and shall pay costs thereby incurred. This includes the furnishing, installing and removing of equipment and piping to provide water for the execution of the Work.

B. The Contractor shall pay the cost of water consumed by trades until Substantial Completion.

C. The Contractor shall provide an adequate supply of cool drinking water with individual drinking cups for personnel on the job.

D. When the permanent water distribution system has been installed, it may be used as a source of water for construction purposes, provided that the Contractor (1) assumes full responsibility for the entire water distribution system; and (2) pays for operation, maintenance and restoration of the system.

E. The Contractor may make use of the available water supply at the Site for construction purposes, provided the permission of the Awarding Authority is obtained beforehand and only as long as the water is not used wastefully.

F. The Contractor shall provide all necessary piping and hoses to utilize the available sources of water.

1.10 TEMPORARY ELECTRICITY

A. The Contractor may make use of the electricity available at the site, metered and paid for by the Awarding Authority, provided that the Contractor shall supply proper adapters and extension cords.
   1. Where heavy duty electric equipment drawing current in excess of 15 amperes is involved, the Contractor shall provide temporary service to supply the power.
   2. The temporary electric service shall include, but not be limited to labor, materials, and equipment necessary to supply temporary power of adequate capacity for the project.
   3. Transformers and meters, when required by the power company, will be furnished by the power company and the contractor shall pay the costs therefore.

B. Temporary electrical Work shall be performed under the direct supervision of at least one master electrician, who will be present on the Project at all times when such work is being performed.

C. The Contractor shall furnish, install, and maintain lamps in operating condition. The Contractor, and each Subcontractor, shall furnish their own extension cords and additional lamps as may be required for their work. Temporary work of a special nature, not otherwise specified hereunder, shall be provided, maintained, and paid for the trade requiring same.

D. All lamps installed in permanent lighting fixtures and used as temporary lights during the construction period shall be removed and replaced shortly before Substantial Completion by the set of lamps required to be provided under the Electrical section of the specifications.

E. All temporary work shall be provided in conformity with the National Electric Code, State laws, and requirements of the power company. Particular

attention is called to Commonwealth of Massachusetts, Department of Labor and Workforce Development Regulations.

F. The Electrical Subcontractor shall dismantle and completely remove from the project Site, temporary electrical facilities only when the permanent electrical system is operational and accepted by the Prime Designer.

1.11 TEMPORARY HEAT - NOT USED

1.12 SECURITY OF THE WORK

A. The Contractor shall be responsible for providing all security precautions necessary to insure adequate protection of the Work and the Awarding Authority's interests until completion of the Work.

B. Where excavation is involved, the Contractor shall be responsible for providing continuous watchmen service as necessary, to insure adequate protection of the general public.

1.13 PROJECT SIGN - NOT USED

1.14 RECORD PROGRESS DRAWINGS (As-Built)

A. Record Progress Drawings (as-built) shall consist of all the Contract Drawings.

B. From the sets of drawings furnished by the Awarding Authority, the Contractor shall reserve sets for record purposes. From one set, the Contractor shall detach and furnish, at no charge to the Subcontractors the drawings of their portion of the Work for the same purpose.

C. The Contractor and the Subcontractors shall keep their marked-up Record Progress Drawing set on Site at all times and note on it in colored ink or pencil, neatly and accurately, at the end of each working day, the exact location of their Work as actually installed. This shall include the location and dimensions of underground and concealed Work, and any civil, architectural, structural, fire protection, plumbing, mechanical or electrical variations from the Contract Drawings. All changes, including those issued by addendum, change order or instructions by the Prime Designer shall be recorded.

Marked-up Record Progress Drawings shall be prepared for the entire Project and include all Work, including but not limited to:

1) The location, elevation and size of underground utilities and appurtenances referenced to permanent surface improvements, both horizontally and vertically:
   a) At ten (10) foot intervals.
   b) At points where such items enter the building and property lines.
   c) At all turns, offsets, and other changes in direction below grade.
   d) At all valves and other appurtenances.
   e) Indicate locations of these items using dimensions to adjacent permanent benchmarks or structures as approved by the Prime Designer. Reliance on scale only to locate any temporary or concealed construction will not be acceptable.
   f) Record Progress Drawings for Work below grade shall be submitted immediately upon completion of utility line installation and prior to concealment of the Work.
2) The location of all internal utilities and appurtenances, concealed by finish materials, including but not limited to valves, coils, dampers, vents, cleanouts, strainers, pipes, junction boxes, turning vanes, variable and constant volume boxes, ducts, traps, and maintenance devices.
   a) The location of these, items shall be shown by offsets to structure and drawing grid lines.
   b) The tolerance for the actual location of these items on the marked up Final Record Drawings shall be plus or minus two (2) inches.
   c) Each item shall be referenced by showing a tag number, areas served, and function on the marked up As Built drawing.
3) If applicable, at the completion of foundations, the Contractor shall furnish to the Awarding Authority a survey, signed by a Land Surveyor or Engineer registered in Massachusetts, certifying that the location of the building(s) and the principal lines, levels, and dimensions of the buildings are accurately established in accordance with the drawings. This drawing shall be the same size as the other drawings in the Contract Documents.

D. The General Contractor shall be responsible for assuring that the various revisions are delineated by the specific trades involved.

E. The Prime Designer or Awarding Authority may periodically inspect the marked-up Record Progress Drawings at the Site. The proper and current maintenance of the information required on these drawings shall be a condition precedent to approval of the monthly applications for payment.

END OF SECTION

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Section 01.50.10
TEMPORARY PROTECTION AND CONTROLS

1.1 GENERAL PROVISIONS

A. All buildings will be occupied during construction. The Contractor shall take all necessary precautions to ensure the public safety and convenience of the occupants during construction.

B. The Contractor shall, at all times, leave an unobstructed way along walks and roadways, and shall maintain barriers and lights for the protection of all persons and property in all locations where materials are stored or Work is in progress.

C. The Contractor shall maintain the construction barriers and traffic barriers in order to accommodate the traffic (both pedestrian and vehicular) around the Work with the maximum of safety and practical convenience to such traffic until completion of the Work. The Contractor shall provide directional signs as required to properly control construction traffic at the Site.

D. The Contractor shall protect all planting, landscaping, trees and site improvements to remain

E. Any damage to buildings, roads (public and private), bituminous concrete areas, fences, lawn areas, trees, shrubbery, poles, underground utilities, etc. shall be made good by and at the Contractor's expense, all to the satisfaction of the Awarding Authority.

F. The Contractor shall patch, repair and/or replace all adjacent materials and surfaces damaged after the installation of new work at no expense to the Awarding Authority. All repair and replacement work shall match the existing in kind and appearance.

G. When applicable, the Contractor shall remove all snow and ice that may impede the Work or safe access, damage the finishes or materials, be detrimental to workers, or impede trucking, delivery, or moving of materials at the Project Site, or prevent adequate drainage of the Site or adjoining areas.

1.2 TEMPORARY PROTECTION

A. The Contractor shall:
   1. Protect excavations, trenches, buildings, and materials at all times from rain water, ground water, backing-up, or leakage of sewers, drains, or other piping, or from water damage of any origin. Provide all pumps, piping,

coverings, and other materials and equipment as required by job conditions to accomplish this requirement.

2. In addition to the weather protection during the months of November to March specified elsewhere, provide temporary watertight enclosures for openings in exterior walls and in roof decks when and as required to protect the Work from damage by inclement weather. Temporary enclosures shall be provided with adequate means of ventilation to prevent accumulation of moisture in the buildings.
3. Provide temporary wood doors for exterior entrances and elsewhere as required. Permanent door enclosures shall not be used as temporary enclosures.
4. Protect sills, jambs, and heads of openings through which materials are handled.
5. Protect decks and slabs to receive work by other trades from any soiling which will prevent proper adhesion of subsequent Work. Decks and slabs shall be left clean and free of blemishes at the time other trades begin the application of their work.
6. Protect concrete slabs to remain exposed and finished floors against mechanical damage, plaster droppings, oil, grease, paint or other material which will stain the floor finish. Install and maintain adequate strips of building paper or other protection on finished floors in areas where other trades will do future Work.
7. Protect all surfaces to receive Work by other trades from any soiling which will prevent proper execution of subsequent Work
8. Protect other areas, furniture and private property of the Awarding Authority. Any areas damaged by the Contractor shall be restored to the original condition or compensated at the Contractor's expense.

B. Roof surfaces and waterproofed surfaces shall not be subjected to traffic nor shall they be used for storage of materials. Where some activity must take place in order to carry out the Work, adequate protection must be provided.

C. After the installation of the Work by any Subcontractor is completed, the Contractor shall be responsible for its protection and for repairing, replacing, or cleaning any such Work which has been damaged by other trades or by any other cause, so that all Work is in first class condition at the time of Substantial Completion.

D. The Contractor shall provide and maintain temporary fencing or barricades around the Work as may be necessary to assure the safety of all persons authorized or unauthorized. Such protective measures shall be located and constructed as required by local, state, and federal ordinances, laws, codes or regulations. When construction site fencing is required, the Contractor shall provide the following.
   1. Construction fence shall be eight (8) feet high and of chain link construction with 6-gauge wire at the top and the bottom of the fencing

material, erected in a substantial manner, straight, plumb and true.

2. Gates shall be built into fence at such approved locations as are necessary, well cross-braced and hung on heavy strap hinges with proper post and hook for double gates. Provide heavy hasps and padlocks for each gate. Provide keys to Awarding Authority to facilitate emergency access by Awarding Authority's Security Forces and local Police and Fire Department.
3. All fencing shall be in accordance with local ordinances and shall be removed at such time before Final Acceptance. Restore site to acceptable condition after removing fence.
4. Provide scrim for fence with design approved and coordinated with the Awarding Authority.

1.3 NOISE CONTROL

A. The Contractor shall take special measures to protect the building tenants, neighbors and general public from noise and other disturbances.

B. Within 7 calendar days after the Notice to Proceed, the Contractor shall prepare and submit to the Prime Designer a noise-abatement plan and enforce strict discipline over all personnel to keep noise to a minimum.

C. Execute construction Work by methods and by use of equipment that will minimize noise.

D. The Contractor shall not permit the use of radios or electronic entertainment equipment to be operated at volume that makes ordinary conversation difficult at ten (10) feet from such equipment.

1.4 DUST CONTROL

A. The Contractor shall take special measures to protect the building tenants, neighbors and general public from dust.

B. Within 7 calendar days after the Notice to Proceed, the Contractor shall prepare and submit to the Prime Designer a dust mitigation plan and enforce strict discipline over all personnel to minimize dust generated at the Site.

C. The Contractor shall maintain the Site, stockpiles, access, detour, and haul roads, staging and parking area used for the Work, free of dust that may cause a hazard or a nuisance to those at the Site, in the building or adjacent sites/buildings.

D. Provide environmentally safe dust control materials and methods to minimize

dust (interior and exterior) from construction operations and to prevent air-borne dust from dispersing into the atmosphere.

E. Schedule operations so that dust and other contaminants resulting from the Work and cleaning process will not fall on wet or newly-coated surfaces, including paint, coatings, sealants, caulking, adhesives.

F. Furnish, erect, and maintain for the duration of the Work period, temporary fire-retardant dust proof coverings and partitions as required to prevent the spread of dust beyond the immediate area where Work is being performed.

1.5 FIRE PROTECTION

A. The Contractor shall take necessary precautions to insure against fire during construction. The Contractor shall be responsible to insure that the area within contract limits is kept orderly and clean and that combustible rubbish and construction debris is promptly removed from the site.

B. Installation of equipment suitable for fire protection shall be done as soon as possible after commencement of the Work. The Contractor's attention is directed to the requirements of the Commonwealth of Massachusetts, Department of Labor and Workforce Development Regulation 454 CMR.

C. When an open flame is used inside a building or when required by the local Fire Department or the Awarding Authority, each contractor (trade) is solely responsible for providing and paying for a **fire watch** to perform their Work.

1.6 WEATHER AND WIND PROTECTION

A. The Contractor shall provide and pay for temporary enclosures and heat to permit Work to be carried on during the months of November through March in compliance with MGL c.149 §44G (d). These specifications are not to be construed as requiring enclosures or heat for operations that are not economically feasible in the opinion of the Awarding Authority. Without limitation this includes such items as excavation, pile driving, steel erection, erection of certain exterior wall panels, roofing and similar operations.

B. "Weather Protection" means the temporary 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 the months of November through March as determined by the Awarding Authority and consistent with the construction schedule to permit the continuous progress of all Work necessary to maintain an orderly and efficient sequence of construction operations. The Contractor shall furnish and install "Weather

Protection" material and be responsible for all costs, including heating required to maintain a minimum 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 conditions set forth in the Contract Documents with added regard to performance obligations of the Contractor.

C. Within 14 calendar days after award of the Contract, the Contractor shall submit to the Prime Designer for approval, in writing, an electronic copy of the proposed methods for "Weather Protection".

D. The Contractor shall assume the entire responsibility for weather protection during construction (until Substantial Completion), and shall be liable for any damage to any Work caused by failure to supply proper weather protection and proper ventilation.

E. Work damaged by frost shall be removed and replaced by and at the Contractor's expense and as directed by the Prime Designer.

F. It is to be specifically understood that the Contractor shall do no Work under any conditions deemed unsuitable by the Contractor to the execution of the Work. This provision shall not constitute any waiver, release, or lessening of the Contractor's obligation to bring the Work to Substantial Completion within the period of time set forth in the Contract Documents.

G. Whenever gale or high winds are forecast by the U.S. Weather Bureau, the Contractor shall take every precaution to minimize danger to persons, to the Work, and to the adjacent property.

1.7 PEST AND RODENT control - NOT USED

1.8 POLICE DETAILS - NOT USED

END OF SECTION

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Section 01.50.20
CLEANING

1.1 RELATED DOCUMENTS

A. This section supplements Article 3.17 of the General Conditions.

B. Consult the individual sections of the specifications for cleaning of Work installed under those sections.

1.2 CLEANING DURING CONSTRUCTION

A. 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 the Site.
   2. Do not dispose of volatile wastes such as mineral spirits, oil or paint thinner in storm or sanitary drains.
   3. Do not dispose of wastes into streams or waterways.

B. Wet down dry materials and rubbish to lay dust and prevent blowing dust.

C. Do not allow materials and rubbish to drop free or be thrown from upper floors, but remove by use of a material hoist or rubbish chutes.

D. Maintain the Site free from accumulations of waste, debris and rubbish.

E. Provide on-site containers for collection of waste materials and rubbish.

F. At the end of each day, remove and legally dispose waste materials and rubbish from site.

G. Vacuum clean interior building areas when ready to receive finish painting, and continue vacuum cleaning on an as-needed basis until Substantial Completion.

H. Schedule cleaning operations so that dust and other contaminants resulting from cleaning process will not fall on wet, newly painted surfaces.

I. Disposal of materials shall be in compliance with all applicable laws, ordinances, codes and by-laws.

1.3 FINAL CLEANING

A. Prior to submitting a request to the Prime Designer to certify Substantial

Completion of the Work, the Contractor shall inspect all interior and exterior spaces and verify that all waste materials, rubbish, tools, equipment, machinery and surplus materials have been removed, and that all sight-exposed surfaces are clean. Leave the Project clean and ready for occupancy.

B. Unless otherwise specified under other sections of the Specifications, the Contractor shall perform final cleaning operations as herein specified prior to final inspection.

C. Cleaning shall include all surfaces, interior and exterior, which the Contractor has had access to, whether new or existing.

D. Employ experienced workmen or professional cleaners for final cleaning.

E. Use only cleaning materials recommended by the manufacturer of the surface to be cleaned.

F. Use cleaning materials which will not create a hazard to health or property and which will not damage surfaces.

G. All broken or defective glass caused by the Contractor's Work shall be replaced at the expense of the Contractor.

H. Remove grease, mastic, adhesive, dust, dirt, stains, labels, fingerprints, and other foreign materials from sight-exposed interior and exterior surfaces. This includes cleaning of the Work of all finishing trades where needed, whether or not cleaning by such trades is included in their respective specifications.

I. Clean and polish all new and existing glass and plastic glazing (if any) throughout the building(s), **on both sides**. Clean plastic glazing in accordance with the manufacturer's directions. This cleaning shall be completed by qualified window cleaners at the expense of the Contractor just prior to acceptance of the Work.

J. Wash and polish all mirrors.

K. Repair, patch, and touch up marred surfaces to the specified finish, to match adjacent surfaces.

L. Polish glossy surfaces to a clear shine.

M. Do the final cleaning of resilient floors and wood floors as specified under the respective sections of the Specifications.

N. Leave all architectural metals, hardware, and fixtures in undamaged, polished conditions.

O. Leave pipe and duct spaces, plenums, furred spaces and the like clean of debris and decayable materials.

P. In cleaning items with manufacturer's finish or items previously finished by a Subcontractor, care shall be taken not to damage such manufacturer's or Subcontractor's finish. In cleaning glass and finish surfaces, care shall be taken not to use detergents or other cleaning agents which may stain adjoining finish surfaces. Any damage to finishes caused by cleaning operations shall be repaired at the Contractor's expense.

Q. Broom clean exposed concrete surfaces and paved surfaces. Rake clean other surfaces of grounds.

R. Ventilating systems - Replace filters and clean ducts, blowers, and coils if units were operated during construction.

S. The Awarding Authority's responsibility for cleaning commences at Substantial Completion.

END OF SECTION

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SECTION 01 56 39
TEMPORARY TREE AND PLANT PROTECTION

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 general protection, pruning and deep root feeding of existing trees that are affected by execution of the Work, whether temporary or permanent construction.

B. Related Sections:
1. Division 01 Section "Temporary Facilities and Controls" for temporary site fencing.
2. Division 31 Section "Site Clearing" for removing existing trees and shrubs.
3. Division 32 Section ‘Plants” for material requirements.

1.03 DEFINITIONS

A. Caliper: Diameter of a trunk measured by a diameter tape at 6 inches above the ground for trees up to, and including, 4-inch size; and 12 inches above the ground for trees larger than 4-inch size.

B. Protection Zone: Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction, and indicated on Drawings.

C. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction, and indicated on Drawings.

D. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.04 QUALITY ASSURANCE

A. Tree Service Firm Qualifications: An experienced tree service firm that has successfully completed temporary tree and plant protection work similar to that required for this Project and that will assign an experienced, qualified arborist to the Project site during execution of the Work.
1. Arborist Qualifications: Massachusetts certified arborist.

B. Preinstallation Conference: Conduct conference at project site with the Owners Representative and the Architect.
1. Review methods and procedures related to temporary tree and plant protection including, but not limited to, the following:
   a. Enforcing requirements for protection zones.
   b. Field quality control.

1.05 SUBMITTALS

A. Tree Pruning Schedule: Written schedule detailing scope and extent of pruning of trees identified for pruning and deep root feeding to remain.
   1. Species and size of tree.
   2. Location on site plan. Include unique identifier for each.
   3. Description of pruning to be performed.
   4. Description of maintenance following pruning.

B. Deep Root Feeding Schedule: Written schedule detailing application rates of trees identified for deep root feeding to remain.
   1. Location on site plan
   2. Species and size of tree with application rates.

C. Qualification Data: For qualified arborist and tree service firm.

D. Certification: From arborist, certifying that trees indicated to remain have been protected during construction according to recognized standards and that trees were promptly and properly treated and repaired when damaged.

E. Maintenance Recommendations: From arborist, for care and protection of trees affected by construction during and after completing the Work.

F. Existing Conditions: Documentation of existing trees and plantings indicated to remain, which establishes preconstruction conditions that might be misconstrued as damage caused by construction activities.
   1. Use sufficiently detailed photographs or videotape.
   2. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plants designated to remain.

1.06 PROJECT CONDITIONS

A. The following practices are prohibited within protection zones:
   1. Storage of construction materials, debris, or excavated material.
   2. Parking vehicles or equipment.
   3. Foot traffic.
   4. Erection of sheds or structures.
   5. Impoundment of water.
   6. Excavation or other digging unless otherwise indicated.
   7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.

B. Do not direct vehicle or equipment exhaust toward protection zones.

C. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones and organic mulch.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Topsoil: Natural or cultivated top layer of the soil profile or manufactured topsoil; containing organic matter and sand, silt, and clay particles; friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects more than 1 inch in diameter; and free of weeds, roots, and toxic and other nonsoil materials.

B. Organic Mulch: Free from deleterious materials and suitable as a top dressing for trees and shrubs, consisting of one of the following:
   1. Type: Shredded hardwood.
   2. Size Range: 3 inches maximum, 1/2 inch minimum.
   3. Color: Natural.

C. Protection Zone Fencing: Fencing fixed in position and meeting the following requirements:
   1. Chain-Link Protection-Zone Fencing: Galvanized-steel fencing fabricated from maximum 2-inch opening, 0.148-inch diameter wire chain-link fabric; with pipe posts, minimum 2-3/8-inch OD line posts, and 2-7/8-inch OD corner and pull posts with 1-5/8-inch OD top rails and 0.177-inch diameter bottom tension wire; with tie wires, hog ring ties, and other accessories for a complete fence system.
      a. Height: 6 feet.
      b. Post setting: 6’-0” on center maximum.
      c. Opening: 3’-0” wide.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Erosion and Sedimentation Control: Examine the site to verify that temporary erosion and sedimentation control measures are in place. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.

3.02 PREPARATION

A. Locate and clearly identify trees, shrubs, and other vegetation to remain. Tie a 1 inch blue-vinyl tape around each tree trunk at 54 inches above the ground for review at the pre-construction meeting.

B. Protect tree root systems from damage caused by runoff or spillage of noxious materials while mixing, placing, or storing construction materials. Protect root systems from ponding, eroding, or excessive wetting caused by dewatering operations.

C. Tree-Protection Zones: Mulch areas inside tree-protection zones and other areas indicated.
   1. Apply 3-inch average thickness of organic mulch. Do not place mulch within 6 inches of tree trunks.

3.03 TREE AND PLANT PROTECTION ZONES

A. Protection-Zone Fencing: Install protection-zone fencing as indicated within Drawings and as directed by the Architect, along edges of protection zones before materials or equipment are brought on the site and construction operations begin in a manner that will prevent people from easily entering protected area except by entrance openings. Construct fencing so as not to obstruct safe passage or visibility at vehicle intersections where fencing is located adjacent to pedestrian walkways or in close proximity to street intersections, drives, or other vehicular circulation.
   1. Chain-Link Fencing: Install to comply with ASTM F 567 and with manufacturer's written instructions.
   2. Posts: Set or drive posts into ground one-third the total height of the fence without concrete footings. Where a post is located on existing paving or concrete to remain, provide appropriate means of post support acceptable to Architect.

B. Maintain protection zones free of weeds and trash.

C. Repair or replace trees indicated to remain that are damaged by construction operations, in a manner approved by the Architect.

D. Maintain protection-zone fencing in good condition as acceptable to Architect and remove when construction operations are complete and equipment has been removed from the site.
   1. Do not remove protection-zone fencing, even temporarily to allow deliveries or equipment access through the protection zone.

3.04 EXCAVATION

A. Trenching near Trees: Where utility trenches are required within protection zones, hand excavate under or around tree roots or tunnel under the roots by drilling, auger boring, or pipe jacking. Do not cut main lateral tree roots or taproots; cut only smaller roots that interfere with installation of utilities.

B. Do not allow exposed roots to dry out before placing permanent backfill. Provide temporary earth cover or pack with peat moss and wrap with burlap. Water and maintain in a moist condition. Temporarily support and protect roots from damage until they are permanently relocated and covered with soil.

3.05 ROOT PRUNING

A. Prune roots that are affected by temporary and permanent construction as directed by the Architect.
   1. Cut roots manually by digging a trench and cutting exposed roots with sharp pruning instruments; do not break, tear, chop, or slant the cuts. Do not use a backhoe or other equipment that rips, tears, or pulls roots.
   2. Cut Ends: Do not paint cut root ends. Coat cut ends of roots more than 1-1/2 inches in diameter with emulsified asphalt or other coating formulated for use on damaged plant tissues and that is acceptable to arborist.
   3. Temporarily support and protect roots from damage until they are permanently redirected and covered with soil.
   4. Cover exposed roots with burlap and water regularly.

5. Backfill as soon as possible according to requirements in Division 31 Section "Earth Moving."

B. Root Pruning at Edge of Protection Zone: Prune roots flush with the edge of the protection zone, by cleanly cutting all roots to the depth of the required excavation.

C. Root Pruning within Protection Zone: Clear and excavate by hand to the depth of the required excavation to minimize damage to root systems. Use narrow-tine spading forks, comb soil to expose roots, and cleanly cut roots as close to excavation as possible.

3.06 CROWN PRUNING

A. Pruning shall be performed in a manner which maintains the natural aesthetic characteristics or the species and variety of trees. No topping or dehorning or trees or stubbing back of branches shall be permitted. All cuts shall be made to a lateral branch. All limbs over 2 inches in diameter to be removed shall be precut to prevent splitting. Any branch that would injure the tree or other objects by falling shall be lowered to the ground by proper ropes.
1. Pruning: Cleaning, thinning, raising and reduction to trees as directed by the Architect.
2. Pruning operations are generally described as the removal and disposal of limbs, branches and stubs which are either dead, decayed, diseased, dying, broken, weak, low hanging, rubbing, potentially detrimental to the health of the tree, dangerous to pedestrians, visually deficient, interfering or otherwise objectionable as determined by the Architect.
3. Pruning Standards: Prune trees according to ANSI A300.
   a. Type of Pruning: Cleaning, thinning, raising and reduction.
4. Aerial lift equipment shall be required for pruning and removal work unless otherwise approved by the Architect.
5. The use of climbing spurs or spiked shoes shall not be permitted.
6. Do not apply pruning paint to wounds.

B. Pruning Schedule:
1. 2019, 2020 - early spring

C. Chip removed branches and spread over areas identified by the Architect or dispose of off-site.

3.07 DEEP ROOT FEEDING

A. Provide deep root feeding (mycorrhizae and fertilizer) to trees identified for pruning and deep root feeding. Arborist shall test and analyze the soils to develop a feeding program and discuss with the Architect the recommended schedule and application rates. Provide 1 deep root feeding to indentified trees to the following application schedule:
1. 2019, 2020– early spring

3.08 REGRADING

A. Lowering Grade: Where new finish grade is indicated below existing grade around trees, slope grade beyond the protection zone. Maintain existing grades within the protection zone.
1. Root Pruning: Prune tree roots exposed by lowering the grade. Do not cut main lateral roots or taproots; cut only smaller roots. Cut roots as required for root pruning.

B. Raising Grade: Where new finish grade is indicated above existing grade around trees, slope grade beyond the protection zone. Maintain existing grades within the protection zone.

3.09 REPAIR AND REPLACEMENT

A. General: Repair or replace trees, shrubs, and other vegetation indicated to remain that are damaged by construction operations, in a manner approved by Architect.
1. Have arborist perform the root cutting, branch pruning, and damage repair of trees and shrubs.
2. Treat damaged trunks, limbs, and roots according to arborist's written instructions.
3. Perform repairs within 24 hours.
4. Replace vegetation that cannot be repaired and restored to full-growth status, as determined by Architect.

B. Trees: Remove and replace trees indicated to remain that are more than 25 percent dead or in an unhealthy condition or are damaged during construction operations as solely determined by the Architect.
1. Provide new tree of same size caliper as those being replaced for each tree that measures 6 inches or smaller in caliper size.
2. Provide 3 new trees of 4”-4 ½” caliper size for each tree being replaced that measures more than 6 “ but less than 12” in caliper size.
3. Provide 4 new trees of 4”-4 ½” caliper size for each tree being replaced that measures more than 12 “ but less than 18” in caliper size.
4. Provide 5 new trees of 4”-4 ½” caliper size for each tree being replaced that measures more than 18” but less than 24” in caliper size.
5. Provide 6 new trees of 4”-4 ½” caliper size for each tree being replaced that measures more than 24 ” in caliper size.
6. Species: Species selected by Architect.
7. Plant and maintain new trees as specified in Division 32 Section "Plants."

C. Soil Aeration: Where directed by Architect, aerate surface soil compacted during construction. Aerate 10 feet beyond drip line and no closer than 36 inches to tree trunk. Drill 2-inch diameter holes a minimum of 12 inches deep at 24 inches o.c. Backfill holes with an equal mix of augered soil and sand.

3.10 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Disposal: Remove excess excavated material, displaced trees, trash and debris, and legally dispose of them off Owner's property.

END OF SECTION 01 56 39

SECTION 01 57 13
TEMPORARY EROSION AND SEDIMENTATION CONTROLS

PART 1 - GENERAL

1.01 PROVISIONS INCLUDED

A. General provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Erosion and sedimentation control devices to minimize erosion and siltation during site construction activities.

B. Related Sections include the following:
1. Division 01 Sections "Stormwater Pollution Prevention Plan".
2. Section 01 56 39 "Temporary Tree and Plant Protection" for protection of trees to remain.
3. Section 31 10 00 "Site Clearing" for tree removal and protection requirements.
4. Section 31 20 00 "Earth Moving" for soil materials, excavating, backfilling, and site grading.

1.03 SUBMITTALS

A. List of proposed materials including manufacturer's product data.

B. Schedule of erosion control program indicating specific dates for implementing programs in each major area or work and each phase of work. Tree removal is not permitted prior to placement of erosion controls devices without written permission from the Architect.

C. Submit a maintenance schedule for erosion control devices for approval by the Architect.

1.04 QUALITY ASSURANCE

A. Inspections: Arrange for the Architect to inspect erosion control measures prior to earthwork operations.

PART 2 - PRODUCTS

2.01 SILT FENCE

A. Silt Fence Fabric: UV protected polypropylene sediment control fabric, Mirafi 140N, Geotex 401 by Propex, or SKAPS GT-160.

B. Posts: Wood posts, minimum length 48 inches. Maximum spacing 8 ft. o.c.

2.02 COMPOST SOCK

A. Prefilled compost sock, 12" diameter, 100% bio-degradable compost fill.

B. Exterior Fabric: Woven polymer.

C. Secured by 2" square wooden stakes placed at 10' intervals.

2.03 CATCH BASIN FILTER

A. Siltsack® - High Flow Siltsack by ACF Environmental.

B. Ultratech Drain Guards by Interstate Products, Inc.

C. Flexstorm Catch-It, by Inlet & Pipe Protection, Inc.

2.04 TEMPORARY SEED COVER

A. Seed mixture shall be fresh, clean, new crop seed. Grass shall be of the previous year's crop and in no case shall weed seed content exceed 1% by weight.
1. All seed shall comply with State and Federal seed laws. Seed which has become wet, moldy or otherwise damaged will not be accepted.

B. Seed mixture and application rate:
1.

Seed Variety	Scientific Name	Germination Minimum	Purity Minimum	Seed Application Rate _____
Annual Rye	Lolium multiflorum	90	95	160 lbs. per acre
Winter Rye	Secale cereale	90	95	200 lbs. per acre

C. Seeding season: Complete seeding operations within the period noted below, unless another seeding time is approved in writing by the Architect.
1. Annual Rye:
   a. Spring seeding: April 15 through June 1.
   b. Fall seeding: September 1 through October 15.
2. Winter Rye:
   a. Late fall seeding: October 1 through November 30.

2.05 TEMPORARY CONSTRUCTION ENTRANCE

A. Stone: 4" minus angular crushed stone. Thickness of crushed stone section to be 6" minimum.

B. Filter Fabric: UV protected polypropylene sediment control fabric, Mirafi 140N, Geotex 401 by Propex, or SKAPS GT-160

2.06 TEMPORARY SEDIMENTATION BASIN OUTLET DEVICE

A. 12" perforated PVC or CPE riser pipe

B. CPE tee and outlet pipe

C. 3/4" – 1 ½" washed crushed stone for filtering within berm section

D. 12" thick section gravel section overlaid on crushed stone section

PART 3 - EXECUTION

3.01 EROSION AND SEDIMENT CONTROL, GENERAL

A. Install erosion control devices before beginning clearing and grubbing operations.

B. When stripping of vegetation, grading, or other soil disturbance is required, conduct operation in a manner which will minimize soil erosion.

C. Retain and protect natural vegetation whenever feasible.

D. Perform earthwork activity on the site in a manner such that runoff is directed to temporary drainage swales and temporary sedimentation basins. Temporary drainage features are to be adjusted and relocated as necessary throughout construction.

E. Minimize the duration and extent of areas which are exposed and free of vegetation.

F. Employ temporary seeding, mulching, or other suitable stabilization measures to protect exposed critical areas, including stockpiles, during prolonged construction or other land disturbance. Refer to the "Stormwater Pollution Prevention Plan" (SWPPP) for timelines and additional requirements for temporary seeding and stabilization practices.

3.02 CATCH BASIN PROTECTION

A. Place catch basin filters at existing inlets to drainage structures. Catch basin filters shall be installed before runoff is allowed to enter the drainage system. Construction and location of catch basin filters are indicated on the Drawings. Install catch basin filters on new catch basins which may receive runoff from disturbed areas until all areas have been stabilized. Install compost sock around the perimeter of catch basins that are located within disturbed or exposed soil areas.

3.03 TEMPORARY SEED COVER

A. Sow seed within the seeding season specified in Part 2 of this section and as approved by the Architect.

B. Seeding: Prepare soil, sow seed, rake, roll and water, until acceptable grass is established.

1. Dry method: Sow grass seed uniformly in two directions by means of a mechanical seeder or other approved method which will sow the seed at the required rate over the entire area to be seeded.

2. Hydraulic spray method: Hydraulic spraying of sowing seed may be used where approved by the Architect. Use an approved machine, capable of distributing seed evenly and uniformly on the designated areas at the required rates, operated by a competent crew

3. In areas having slopes of 3:1 or steeper, and in drainage swales, over seed with the same mixture in a separate operation immediately after sowing. Apply over seeding mixture at the rate of 3 pounds per 1,000 square feet. Cover areas that require additional erosion control with approved erosion netting properly anchored. Remove non-degradable netting after an acceptable stand of grass has been achieved.

C. Irrigate until equivalent of a 2 in. depth of water has been applied to entire seeded surface, at a rate which will not dislodge seed. Repeat watering as frequently as required to prevent drying of surface, until grass attains an average height of 1-1/2 in.

3.04 MAINTENANCE AND REMOVAL OF EROSION CONTROL DEVICES

A. Environmental Protection: Provide protection, operate temporary facilities and conduct site preparation operations in such a way to prevent transport of sediment to storm drains.

B. Keep culverts and drainage ditches clean and clear of obstructions during construction period.

C. Erosion control devices:
1. Check sediment behind the erosion control devices at least once every 7 calendar days and within 24 hours of a 0.25-inch or greater storm event. Remove sediment when it has accumulated to ½ the design height or capacity of the measure, and as need.
2. Check condition of erosion control devices at least once every 7 calendar days and within 24 hours of a 0.25-inch or greater storm event. Replace damaged and/or deteriorated items. Maintain erosion control devices in place and in effective condition.
3. Legally dispose of sediment deposits off-site.

D. Removal of Erosion Control Devices:
1. Maintain erosion control devices until all disturbed earth has been paved or planted and stabilized as approved by the Architect.
2. Remove and dispose of erosion control devices when directed by the Architect.
3. Following removal, re-grade and seed disturbed areas.

END OF SECTION 01 57 13

Section 01.73.29
CUTTING AND PATCHING

1.1 RELATED DOCUMENTS

A. This section supplements Article 3.3 of the General Conditions.

B. Consult the individual sections of the Specifications for specific items required under those sections.

1.2 DEFINITIONS

A. Cutting: Removal of in-place construction necessary to permit installation or performance of other Work.

B. Patching: Fitting and repair Work required to restore surfaces to original conditions after installation of other Work.

C. Coring: Any new penetration cut through existing or new construction using core drill and measuring no more than 6 inches in diameter or 6 inches by 6 inches. Larger cores are considered under cutting.

1.3 WORK INCLUDED

A. Unless specified elsewhere, the Contractor shall be responsible for:
   1. All cutting and patching required for the project construction.
   2. Products and installation for patching and extending Work.
   3. Transition and adjustments.
   4. Repair of damaged surfaces, finishes, and cleaning

B. Cut existing construction to provide for installation of other components or performance of other construction activities and the subsequent fitting and patching required to restore surfaces to their original condition.

1.4 RESPONSIBILITY FOR CUTTING AND PATCHING

A. General: All cutting and patching shall conform to the requirements of this Section, whether or not the work is to be done by the Contractor, a Filed Subcontractor or other Subcontractor.
   1. Patching shall be performed so as to maintain the integrity of adjacent construction.
   2. Patching shall be performed to maintain the integrity of the fire-rated

construction at penetrations.

B. Coordination: Unless otherwise specified, the General Contractor shall be responsible for the following:
   1. All cutting and patching required for the Project construction.
   2. Products and installation for patching and extending Work.
   3. Transition and adjustments.
   4. Repairing damaged surfaces, finishes and cleaning.
   5. Obtaining locations and dimensions of penetrations required through walls and floors from trades requiring penetrations.
   6. Coordinating penetrations with the requirements of other trades.
   7. Forwarding locations and dimensions of requested penetrations to the trades responsible for performing the cutting and patching work.

C. Structural Elements: Do not cut and patch structural elements in a manner that will change their load-carrying capacity or load-deflection ratio.

D. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety. Operating elements include but are not limited to the following:
   1. Primary operational systems and equipment.
   2. Air or smoke barriers.
   3. Partitions and other construction required to provide acoustical separation.
   4. Fire-suppression systems.
   5. Mechanical systems piping and ducts.
   6. Control systems.
   7. Communication systems.
   8. Conveying systems.
   9. Electrical wiring systems.

E. Miscellaneous Elements: Do not cut and patch miscellaneous elements or related components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety. Miscellaneous elements include but are not limited to the following:
   1. Water, moisture, or vapor barriers.
   2. Membranes and flashings.
   3. Exterior curtain-wall construction.
   4. Equipment supports.
   5. Piping, ductwork, vessels, and equipment.
   6. Noise- and vibration-control elements and systems.

F. Visual Requirements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch construction exposed on the exterior or in occupied spaces in a manner that

would, in Prime Designer's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

G. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during cutting and patching operations, by methods and with materials so as not to void existing warranties.

H. Coring: All coring shall be performed by the trade requiring the new penetration.

1.5 EXAMINATION

A. Examine surfaces to be cut and patched and conditions under which cutting and patching is to be performed before cutting, including elements subject to damage or movement during cutting and patching.

B. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.

C. Compatibility: Before patching, verify compatibility with and suitability of substrates, including compatibility with in-place finishes or primers.

D. Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.

E. Beginning of cutting or patching means acceptance of existing conditions.

F. After uncovering existing Work, assess conditions affecting performance of work.

1.6 PREPARATION

A. Employ skilled workmen to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time and complete without delay.

B. Before proceeding, meet at the Project Site with parties involved in cutting and patching, including mechanical and electrical trades. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

C. Provide temporary supports to ensure structural integrity of the Work. Provide devices and methods to protect other portions of Project from damage.

D. Close openings in exterior surfaces to protect existing Work [and salvage items] from weather and extremes of temperature and humidity. Insulate duct work and piping to prevent condensation in exposed areas.

E. Cut, move or remove items as necessary for access to alterations and renovation Work. Replace and restore at completion.

F. Remove unsuitable material not marked for salvage, such as rotted wood, corroded metals, and deteriorated masonry and concrete. Replace materials as specified for finished Work.

G. Remove debris and abandoned items from area and from concealed spaces.

H. Prepare surface and remove surface finishes to provide for proper installation of new Work and finishes.

1.7 CUTTING

A. Execute all cutting and fitting necessary to complete the Work.

B. Where services are required to be remove, relocated, or abandoned, by-pass utility services, such as pipe or conduit, before cutting. Cut-off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal the remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after by-passing and cutting.

C. Uncover work to install improperly sequenced Work.

D. Remove and replace defective or non-conforming Work.

E. Provide openings in the Work for penetration of mechanical and electrical work. Cut holes and slots as small as possible, nearly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover opening when not in use.

F. Employ skilled and experienced workers to perform cutting for weather exposed and moisture resistant elements, and sight exposed surfaces.

G. Cut rigid materials using power saw or core drill. Cut through concrete and masonry using a cutting machine, such as a Carborundum saw or a diamond-core drill. Pneumatic tools shall not be allowed without prior approval.

H. Cut existing construction using methods least likely to damage elements retained or adjoining construction. Where possible, review proposed procedures with the original Installer; comply with the original Installer's recommendations.

I. To avoid marring existing finished surfaces, cut or drill from the exposed or finished side into concealed surfaces.

J. Comply with requirements of applicable Division 31- Earthwork sections where cutting and patching requires excavating and backfilling.

K. Do not cut structural elements in a manner that will change their load-carrying capacity or load-deflection ratio.

L. Do not cut operating elements or related components in a manner that would result in reducing their capacity to perform as intended. Do not cut operating elements or related components in a manner that would result in increased maintenance or decreased operational life or safety.

1.8 PATCHING

A. Execute patching to complement adjacent and undisturbed finishes.

B. Fit products together to integrate with other Work.

C. Execute Work by methods to avoid damage to other Work, and which will provide appropriate surfaces to receive patching and finishing.

D. Restore Work with new products in accordance with requirements of Contract Documents.

E. Fit work tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.

F. At penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids with appropriate material to full thickness of the penetrated element as necessary to maintain the required rating.

G. Where new Work abuts or aligns with existing, perform a smooth and even transition. Patch work to match existing adjacent work in texture and appearance. Refinish surfaces to match adjacent finish. For continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.

H. Use materials identical to existing materials. For exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible if identical materials are unavailable or cannot be used. Use materials whose installed performance will equal or surpass that of existing materials.

I. Patch with durable seams that are as invisible as possible. Comply with specified tolerances.

J. Where feasible, inspect and test patched areas to demonstrate integrity of the installation.

K. Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.

L. Where walls or partitions are to be removed, patch and repair voids left in floor, wall and ceiling surfaces where the existing construction is removed. Provide an even surface of uniform color and appearance. Remove existing floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.

M. Where patching occurs in a smooth painted surface, extend final paint coat over entire unbroken surface containing the patch after the area has received primer and second coat.

N. Patch, repair, or re-hang existing ceilings as necessary to provide an even-plane surface of uniform appearance.

O. Refer to applicable Sections of Division 9 - Finishes for plastering requirements. In lieu of specific requirements, comply with the following:
   1. Comply with ASTM C 842
   2. Comply with manufacturer's instructions and install thickness and coats as indicated.
   3. Unless otherwise indicated, provide 3-coat work.
   4. Base Coat: Ready-mixed, sand aggregate gypsum plaster base.
   5. Finish Coat: Ready-mixed gypsum finish plaster.
   6. Finish gypsum plaster to match existing adjacent surfaces. Sand lightly to remove trowel marks and arises.

1.9 CLEANING

A. In addition to cleaning specified in Section 01.50.20, clean all areas affected by the Work of this Section.

B. Completely remove paint, mortar, oils, putty, and similar items.

C. Thoroughly clean piping, conduit, and similar features before applying paint or other finishing materials. Restore damaged pipe covering to its original condition.

END OF SECTION

Section 01.77.00
PROJECT CLOSEOUT PROCEDURES

1.1 RELATED DOCUMENTS

A. This section supplements the General Conditions.

B. Consult the individual sections of the specifications for specific items required under those sections.

1.2 OCCUPANCY PERMIT

A. The Contractor shall coordinate the efforts of all Subcontractors and obtain the Occupancy Permit from the Building Department or Department of Public Safety. The Contractor shall pay any Building Department fee associated with the Occupancy Permit.

1.3 PARTIAL COMPLETION

A. The Awarding Authority may take partial occupancy of the Work area as specified in Article 8.5 of the General Conditions.

B. If partial occupancy is requested, the Prime Designer shall conduct a thorough inspection of the Work. If the area is actively occupied, this inspection shall occur within 24 hours of any written request. The Prime Designer shall prepare a punch list, setting forth in accurate detail any items and additional items that are not acceptable or incomplete inside the building/area. The Contractor shall coordinate all Subcontractors to achieve prompt completion of the punch list.

C. Prior to requesting Prime Designer's inspection, the Contractor shall make a thorough inspection of the Work. During this inspection, the Contractor shall prepare a comprehensive list of all items remaining to be completed or corrected. This list shall include all remaining Contractor and Subcontractor items to be provided under the Contract Documents.

1.4 SUBSTANTIAL COMPLETION

A. When in the opinion of the Contractor the Work is substantially complete, the Contractor shall follow the procedures as specified in Article 8.6 of the General Conditions.

B. At Substantial Completion, the Contractor shall submit to the Prime Designer the following items:
   1. Operating and maintenance data.
   2. Schedule for training and instruction on new fire protection, plumbing, mechanical and electrical systems.
   3. Guarantees and warranties as specified.
   4. Keys and keying schedule.
   5. Spare parts and maintenance materials as specified.
   6. Roofing guarantee and flashing endorsement as specified.
   7. Evidence of compliance with requirements of governing authorities.
   8. Punch list with schedule.
   9. Complete set of marked up Final Record Drawings. The Contractor shall check all marked up record drawings prepared by Subcontractors and certify in writing on the title sheet of the drawings that they are complete and correct, prior to submission to the Prime Designer.

1.5 TRAINING AND INSTRUCTIONS

A. As required in the Contract Documents and prior to final payment and completion, the Contractor and Subcontractors shall instruct the Awarding Authority's personnel at the Site, in the use and maintenance of equipment installed under the Contract.
   1. The intent is to furnish detailed instruction and to educate the Awarding Authority's on-site personnel in the proper use of the equipment.
   2. The instruction shall be provided by a qualified trainer, who is also a manufacturer’s certified technician, with expertise with the specific system or equipment for which training is required. In some cases, the training may require more than one visit by those responsible for the instruction.
   3. The Contractor and, in particular, the Plumbing, Heating and Ventilating, and Electrical Subcontractors shall not assume that the Awarding Authority's personnel possess special expertise or have any previous experience whatsoever in the operation and maintenance of mechanical and electrical equipment.
   4. Submit the schedule for instructional training to the Awarding Authority. Do not proceed with instruction until Awarding Authority has approved schedule.
   5. Refer to specific technical sections for additional requirements specific to particular equipment and systems.
   6. For major items of mechanical and electrical equipment, instructions and demonstrations shall be performed during the initial start-up period and, if necessary, during one or more return visits as may be required.

B. The Contractor shall submit in writing to the Prime Designer a certificate of compliance with the training requirements, signed by the Contractor and the Awarding Authority's representative, as a condition of final payment.

1.6 FINAL RECORD DRAWINGS

A. Final Record Drawings shall consist of all the Contract Drawings.

B. Prior to final payment and completion, the Contractor shall provide one full size set and one electronic copy (PDF format) of the Final Record Drawings (as-built). The Contractor shall transcribe all previously recorded information from the Record Progress Drawings (see Section 01.50.00, paragraph 1.4) and ensure that all trades properly annotated all modifications or deviations from the Contract Drawings.
   1. The annotated drawings shall include all addenda, sketches, field directives, change orders or other Work issued during construction.
   2. Shop drawings will not be accepted as the Final Record Drawings.

C. The Contractor shall check all marked-up record drawings prepared by Subcontractors and shall certify in writing on the title sheet of the drawings that the drawings are complete and correct, prior to submission to the Prime Designer.

D. The Contractor shall submit the Final Record Drawings to the Prime Designer. The Prime Designer shall incorporate all changes onto to original drawings.

E. The Prime Designer shall be the sole judge of the acceptability of the Final Record Drawings.

1.7 RECORD SUBMITTALS AND CLOSEOUT DOCUMENTS

A. Prior to final payment and completion, the Contractor shall collect and submit two (2) hard copy complete sets (three ring binders) and one electronic copy (PDF format) of all the record documents. Each subcontractor (trade) shall be responsible for compiling and providing the required closeout documents to the Contractor for their Work (trade). The sets shall be organized logically, properly labeled and include the following documents.
   1. Final project directory.
   2. Copy of the final signed permit and Certificate of Occupancy (if required).
   3. Copy of the Certificate of Substantial Completion.
   4. All warranties by the individual trades.
   5. All manufacturer warranties as specified.
   6. All record submittals with the action taken by the Prime Designer.
   7. All Operation and Maintenance Manuals - Maintenance manuals shall consist of manufacturer's catalog cuts with descriptive information, lubricating and maintenance instructions, parts lists, usage instructions, names, addresses and telephone numbers where replacement parts and service can be quickly obtained, and all other information required for the Awarding Authority to use, maintain, and service the items properly
   8. Stamp surveys, if applicable.

B. Subcontractors, installers and suppliers shall furnish to the Contractor two sets of operating and maintenance instructions manuals of all mechanical, electrical and manually operated equipment furnished and installed under the Contract.

C. The Contractor shall submit the complete sets of record documents to the Prime Designer to review for completeness and the Prime Designer will deliver the sets to the Awarding Authority.

1.8 FINAL COMPLETION

A. The Contractor's attention is directed to Article 8.7.

B. Partial Release of Retainage:
   1. If within 60 days after Substantial Completion, any of the items on the Prime Designer's punch list are not complete or if the Contractor has not provided the appropriate marked up As Built Drawings, operating manuals, warranties, guarantees, record submittals or spare parts, the Prime Designer shall assign a monetary value for each incomplete item as well as any other items as provided by M.G.L. c.30 §39K, and the Prime designer shall prepare a Certificate for Partial Release of Retainage.
   2. If the Prime Designer is required to prepare a Certificate for Partial Release of Retainage, the Contractor shall complete all remaining Work in accordance with the provisions of Article 8.7 of the General Conditions.
   3. The Contractor’s signature on this Certificate shall be notarized.
   4. The Contractor may make a request for additional releases of retainage when portions of the Work listed on the Prime Designer's punch list have been satisfactorily completed. Each request shall be accompanied by a new application for payment and a new signed and notarized Certificate for Partial Release of Retainage.
   5. The Prime Designer's inspections, required to complete the additional payment applications described in subparagraph above, are subject to provisions of Article 8.7.5 of the General Conditions.
   6. Upon completion of all remaining items, the Final Release of Retainage shall be processed in accordance with provisions above in this paragraph.

C. Full Release of Retainage:
   1. Upon completion of all Work and after receipt of all appropriate marked up As Built Drawings, operating manuals, warranties, guarantees, record submittals and spare parts required by the Contract Documents, the Prime Designer shall prepare the Certificate of Final Completion.
   2. The Contractor’s signature on this Certificate shall be notarized.
   3. The Contractor shall provide a final Application for Payment to complement the close-out process.

END OF SECTION

SECTION 01 91 13

GENERAL COMMISSIONING

PART 1 - GENERAL

1.01 SUMMARY

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 1 – GENERAL REQUIREMENTS, which are hereby made a part of this Section of the Specifications.

B. Section includes general and specific requirements that apply to the implementation of commissioning process for HVAC&R systems, assemblies, and equipment. Commissioning includes, but is not limited to, the following systems:
   1. HVAC Systems:
      a. Individual components and equipment.
      b. Overall system: Interaction of cooling, heating, and comfort delivery systems.
   2. Lighting Control System:
      a. Lighting, and lighting controls including occupancy sensors.
   3. Domestic Water Systems:
      a. Domestic water heaters and storage.
      b. Water conservation devices.

C. Related Sections: Specific commissioning related sections may contain additional requirements specifying the relationship of general work provisions in conjunction with commissioning.

D. The Owner, Architect, Engineer, and Commissioning Agent are not responsible for construction means, methods, job safety, or management related to commissioning on the job site.

E. Commissioning is the process to verify to the owner that systems, equipment, mechanical, electrical, and controls function together properly to meet performance requirements and design intent as shown in the contract documents. The Contractor shall be responsible for participation in the commissioning process as outlined below, and in references and attachments throughout the contract documents. Commissioning procedures will be designed and coordinated by the Commissioning Agent (CA), hereinafter referred to as CA.

1.02 RELATED SECTIONS

A. Section 01 77 00, PROJECT CLOSEOUT PROCEDURES.

B. Section 22 00 01, PLUMBING.

C. Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.

D. Section 23 00 01, HVAC.

E. Section 23 08 00, COMMISSIONING OF HVAC.

F. Section 26 00 01, ELECTRICAL.

G. Section 26 08 00, COMMISSIONING OF ELECTRICAL.

1.03 ABBREVIATIONS AND DEFINITIONS

A. Acceptance Phase: The phase of construction after startup and initial checkout when functional performance tests, O&M documentation review and training occurs.

B. BoD: Basis of Design. A document produced by the design team that records concepts, calculations, decisions, and product selections used to meet the Owner's Project Requirements (OPR) and to satisfy applicable regulatory requirements, standards, and guidelines. The document includes both narrative descriptions and lists of individual items that support the design process.

C. Commissioning Plan: A document that outlines the organization, schedule, allocation of resources, and documentation requirements of the commissioning process.

D. CA: Commissioning Agent/Commissioning Authority. An entity who leads, plans, schedules and coordinates the Cx team to implement the Cx process.

E. Contractor's Pre-Commissioning Checklists: includes installation and start-up items as specified to be completed by the appropriate contractors prior to the Cx process.

F. Cx: Commissioning. Commissioning is a comprehensive and systematic process to verify that the building systems perform as designed to meet the Owner's requirements. Commissioning during the construction, acceptance, and warranty phases is intended to achieve the following specific objectives:
   1. Verify and document that equipment is installed and started per manufacturer's recommendations, industry accepted minimum standards, and the Contract Documents.
   2. Verify and document that equipment and systems receive complete operational checkout by installing contractors.
   3. Verify and document equipment and system performance.
   4. Verify the completeness of operations and maintenance materials.
   5. Ensure that the Owner's operating personnel are adequately trained on the operation and maintenance of building equipment.

The commissioning process does not take away from or reduce the responsibility of the system designers or installing contractors to provide a finished and fully functioning product.

G. Cx Plan: A document that outlines the organization, schedule, allocation of resources, and documentation requirements (guidelines) of the Cx process.

H. Design Intent: a dynamic document produced by the design team that provides the explanation of the ideas, concepts and criteria that are considered to be very important to the Owner.

I. Final Commissioning Report: includes the overall final Cx documents, prepared by the CA, which details the actual Cx procedures performed, inspection and testing results, and the final version of the issues list indicating that all issues discovered through the Cx process have been verified as resolved or accepted. The report also includes key items for the maintenance staff such as fan and pump curves for the equipment furnished.

J. Functional Performance Test (FPT): test of the dynamic function and operation of equipment and systems using manual (direct observation) or monitoring methods. Functional testing is the dynamic testing of systems (rather than just components) under full operation (e.g., the chiller pump is tested interactively with the chiller functions to see if the pump ramps up and down to maintain the differential pressure setpoint). Systems are tested under various modes, such as during low cooling or heating loads, high loads, component failures, unoccupied, varying outside air temperatures, fire alarm, power failure, etc. The systems are run through all the control system's sequences of operation and components are verified to be responding as the sequences state. Traditional air or water test and balancing (TAB) is not functional testing, in the commissioning sense of the word. TAB's primary work is setting up the system flows and pressures as specified, while functional testing is verifying that which has already been set up. The Commissioning Agent develops the functional test procedures in a sequential written form, coordinates, oversees and documents the actual testing, which is usually performed by the installing contractor or vendor. Functional Performance Tests are performed after prefunctional checklists and startups are complete.

K. General Contractor (GC) – Main contractor responsible for overall construction activity.

L. HVAC&R: Heating, Ventilating, Air Conditioning, and Refrigeration.

M. Installation Checklist: Checklist shall be by system or equipment to verify submittal information and installation match. Review complete system installation, cleaning, initial settings, and verify systems are ready for operation. Requires final sign-off by the contractor prior to continuing with the Cx process.

N. Issues Log (Deficiencies List): includes a list of noted issues discovered as a result of the Cx process. This list also includes the current disposition of issues, and the date of final resolution as confirmed by the CA. Issues are defined as those issues where products, execution or performance do not satisfy the specifications and/or the design intent.

O. Owner-Contracted Tests: tests paid for by the owner outside the GC's contract and for which the CA does not oversee. These tests will not be repeated during functional tests if properly documented. E.G. Fire Marshall demonstration tests etc.

P. Owner's Project Requirements (OPR) -- supplements Design Intent. A detailed, largely non-technical document developed in conjunction with the Architect under the leadership of the CA based on discussions with the facility owner. It states the concepts, budget, and performance criteria (including functional requirements) to which the completed project must conform (includes expectations of how the building will be used and operated). This document is the basis for building commissioning, and includes items such as project goals, measurable performance criteria, cost considerations, benchmarks, success criteria, and supporting information.

Q. Pre-Functional Checklist.

R. Pre-Functional Procedures (PFP).

S. Seasonal/Deferred FPTs: that are deferred until the system(s) will experience environmental conditions closer to their design conditions.

T. Systems, Subsystems, Equipment, and Components: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, equipment, and components.

1.04 COMMISSIONING TEAM

A. Overview: The Cx Team will consist of all members needed to execute the approved Cx program. This includes, at a minimum the CA, the Contractor and its subcontractors, the owner's staff, the Architect, the mechanical engineer, and the electrical engineer.

B. Members Appointed by contractor(s): individuals, each having the authority to act on behalf of the entity he or she represents, explicitly organized to implement the Cx process through coordinated action. The Cx team shall consist of, but not be limited to, representatives of contractor, including project superintendent and subcontractors, installers, suppliers, and specialists deemed appropriate by the CA, EG, TAB and DDC controls specialist.

C. Members Appointed by Owner:

1. CA: The designated person, company, or entity that plans, schedules, and coordinates the Cx team to implement the Cx process.
2. Typically the owner or owner's representative will engage the CA under a separate contract; however, under certain circumstances the CA may also be an owner employee or staff member, or a disinterested employee or subcontractor of the general contractor, construction manager, or A/E.
3. Representatives of the facility user and operation and maintenance personnel.
4. Architect and engineering design professionals.

1.05 COMMISSIONING PLAN

A. The Commissioning Specification initiated by the Owner and updated by the AE, outlines the roles and responsibilities of the Contractors. As a separate document, the Commissioning Plan will provide a broader outline of the entire commissioning process, including the following:
   1. Design Phase Commissioning Activities.
   2. Occupancy & Operation Commissioning Activities.
   3. Roles and Responsibilities of all Commissioning Team Member.

   The Owner will forward the Commissioning Plan to the Contractors via the PM, who then makes the Plan available on request to the Contractor.

B. Impact on Contractor Responsibility: The Cx Process does not reduce the responsibility of the installing contractors to provide a finished and fully functioning product. The CA does not have the authority to provide direction to the Contractors. Any issues arising during the Commissioning Process which impact schedules, costs or contractual obligations shall be addressed to the Owner for resolution.

C. Commissioning Scope: The scope of Cx is to verify building systems' performance and operation per the contract documents. Cx of this project is intended to:
   1. Inspect and verify that equipment and systems have been installed in accordance with the contract documents and manufacturer's written installation instructions.
   2. Evaluate the results of operational and functional tests for each system per acceptance criteria as defined in the contract documents.
   3. Review contractor as-built/as-installed shop drawings, schematics, one-line diagrams, etc.
   4. Review O&M manuals.
   5. Inspect and verify the performance of each piece of equipment and its system, as described in the project documents.
   6. Test the interrelationship of systems and equipment to verify performance and sequence of operation.
   7. Review contractor training of the owner personnel in the proper operation of equipment and systems. Evaluate training program and make recommendations to the owner for approval or retraining requirements.

8. Identify, document, and report, for tracking and correction, all issues of the work versus contract documents and performance requirements as it pertains to specific system commissioning.
9. Make a recommendation to the owner as to whether the systems should be accepted based on the results of the tests compared with the contract documents.

D. Commissioning Process:
   1. The documented procedures which comprise the construction-phase commissioning process include the following:
      a. Pre-Commissioning consists of normally specified check-outs or testing, wiring and controls point-to-point verification, etc. to be completed by the respective Contractor before the formal commissioning process outlined in this document begins.
      b. Pre-Functional Procedures (PFPs) consist of a series of field observations conducted during the installation of equipment yet to be commissioned to verify that equipment is installed per the contract documents and is ready for startup.
      c. Contractor Pre-Startup Testing consists of normally specified Contractor testing such as leak testing of ductwork and piping. The commissioning process is used to ensure that this testing is rigorously executed and documented in preparation for equipment startup.
      d. Equipment Startup Procedures ensure that startup is performed per the equipment manufacturer's recommended procedures and those startup activities and data are documented for future reference.
      e. Contractor TAB Plan submitted to the Owner via the Contractor no later than 30 days prior to scheduled Start up shall include sufficient narrative and technical detail identifying the relevant systems, components, instrumentation and sequence of work. This Plan shall also indicate evidence of all presets in preparation.
      f. Contractor Post-Startup Testing consists of normally specified contractor testing activities occurring after startup including TAB of ventilation and hydronic systems, control system point-to-point testing. The commissioning process provides oversight during the execution and documentation of these tests to ensure successful system operation.
      g. Witnessing Functional Performance Procedures (FPPs) consists of determining if equipment, sub-systems and major systems operate in accordance with the design intent and the contract documents. Specific issues, which will be evaluated in these procedures, include equipment capacity & efficiency, operation of safeties and interlocks, control system operation, stability and tuning. All post start-up work including debugging is to be completed prior to Functional Performance Witnessing by the Owner.
      h. Operation and Maintenance Manuals will be reviewed by the Owner for both content and organization. The objective of the review process is to provide the Owner with useful, complete, project-specific information needed to successfully operate and maintain the facility after turnover.

i. Operator Training will be provided and coordinated by the Contractor / [CM/GC] and overseen by the Owner to help ensure that the Owner is adequately prepared to operate and maintain the facility at turnover. Scheduling of Training is to be confirmed in writing no later than the earlier of either Substantial Completion or as this Project requires.

1.06 OWNER'S RESPONSIBILITIES

A. Ensure the participation of owner's chosen representatives as required to complete the Cx process.

B. Provide the OPR and BoD documentation to the CA and each contractor for information and use.

C. Assign O&M personnel and schedule them to participate in Cx team activities.

D. Provide the BoD documentation, prepared by the architect and approved by the Owner, to the CA and each contractor for use in developing the Cx plan, systems manual, and O&M training plan.

1.07 ARCHITECT/ENINGEER'S RESPONSIBILITIES

A. Review the Cx documentation and provide comments as necessary to the CA and the Owner.

B. The Architect shall ensure the participation of necessary representatives from the design team as required to complete the Cx process. Design team members will be expected to provide prompt replies to Cx review reports and RFI requests issued during the Cx process. Copies of all submittals, RFI's and ASI's pertaining to equipment to be commissioned shall be transmitted to the CA for review and comment.

C. Participate in determination of final controls system input/output points list and sequences of operation as required to complete functional test procedures with the owner's representative, CA, and controls contractor.

1.08 CONTRACTOR'S RESPONSIBILITIES

A. General:
1. Contractors providing and/or installing equipment and systems included in the 'Scope of Work' above are required to participate fully in the Commissioning Process.

2. Participating Contractors shall include all costs to complete the Cx requirements in their contract price including all costs for Sub-Contractors, vendors and suppliers.
3. Contractors shall perform commissioning tests at the direction of the CA.
4. Participating Contractors shall ensure acceptable representation, with the means and authority to prepare, coordinate and execute the Commissioning Process as described in the contract documents.
5. Contractors shall participate in the resolution of system deficiencies identified during the commissioning process, according to the contract documents and the Owner's Project Requirements.
6. Contractors shall prepare & submit the final as-built design intent and operating parameter documentation for inclusion in the O&M manuals.
7. Contractors to provide information requested by the CA for final commissioning documentation.
8. Contractors shall provide measuring instruments and logging devices to record test data, and provide data acquisition equipment to record data for the complete range of testing for the required test period.

B. Contractor's Commissioning Representative (CCR):
   1. Each Contractor participating in the Cx Process will each designate a single-point contact person to work with the Owner and the Commissioning Team to coordinate commissioning activities, ensure timely execution of Cx Procedures and prompt resolution of commissioning issues.
   2. CCR shall attend construction phase controls coordination meeting.
   3. Participate in HVAC&R systems, assemblies, equipment, and component maintenance orientation and inspection as directed by the CA.
   4. The CCR shall be the Contractor's Project Manager, Field Superintendent or similar with authority to do the following:
      a. Make decisions regarding commissioning activities and issues.
      b. Schedule technicians for participation in commissioning activities.
      c. Interface between the Commissioning Team and the Contractor's Sub-Contractors, vendors and suppliers.
      d. Commit to commissioning schedules and completion dates.
   5. The CCR will be responsible for coordinating the Contractor's participation in the Cx Process. As part of this role, the CCR shall:
      a. Attend all Commissioning Meetings.
      b. Keep the Contractor, AE, and/or Owner apprised of the Contractor's progress, schedules and other matters impacting execution of the Commissioning Procedures.
      c. Coordinate the Contractor's work schedules and staffing to ensure that the qualified technician(s) are available and present during the agreed upon schedules and for sufficient duration to complete procedures, tests, adjustments, and/or problem resolutions.
      d. Ensure that the Contractors Commissioning Notebook(s) and Contractor Commissioning Documents are being maintained on-site, well organized and current as required in item the 'Commissioning Documentation' paragraph of

this specification. Notebooks and Contractor Commissioning Documents shall be turned over to the Owner as part of the required deliverables for Final acceptance.

6. The Owner reserves the right to question the appropriateness and qualifications of the Contractor's Commissioning Contact. Qualifications shall include expert knowledge of the equipment and systems being commissioned and a willingness to work cooperatively with Commissioning Team.

C. Field Technicians:
   1. Each Contractor shall provide qualified field technicians who are trained and familiar with installation, operation and troubleshooting of systems and equipment being commissioned for participation in the commissioning activities outlined in this document.
   2. These same technicians shall be made available to assist the Owner in resolving commissioning issues (as reported on the Issue Tracking Report) and for repeat and follow-up commissioning tasks as required.
   3. Contractors shall arrange for and provide technicians from their Sub-Contractors, vendors and suppliers where specified and where Contractor's own personnel lack the required training or experience necessary to ensure that all commissioned equipment and systems are correctly installed and fully functional.
   4. System performance problems and discrepancies may require additional technician time, Owner time, reconstruction of systems, and/or replacement of system components. The additional technician time shall be made available for subsequent Cx periods at no cost to the Owner until the required system performance is obtained.
   5. The Owner reserves the right to question the appropriateness and qualifications of the technicians relative to each item of equipment, system, and/or sub-system. Qualifications of technicians shall include expert knowledge relative to the specific equipment involved.

1.09 COMMISSIONING AGENT'S RESPONSIBILITIES

A. Organize and monitor the commissioning team.

B. Prepare an initial Commissioning Plan (Cx Plan). Collaborate with each Contractor and with subcontractors to develop test and inspection procedures. The Cx Plan is a dynamic document that is continuously updated through Design, Construction and Warranty. Updates shall be provided by the AE / Contractor during and post construction. The Cx Plan shall identify commissioning team member(s) / their responsibilities, by name, firm, and trade specialty, for performance of each commissioning task. Scheduled commissioning activities shall be coordinated with overall Project schedule.

C. Participate in the commissioning team meetings for the purpose of monitoring progress, coordination, communication, and conflict resolution. Contractor to provide meeting minutes.

D. At the beginning of the construction phase, the CA shall coordinate through the AE and conduct an initial construction-phase coordination meeting for the purpose of reviewing the commissioning activities and establishing tentative schedules for operation and maintenance submittals; operation and maintenance training sessions; TAB Work; and Project completion.

E. The CA will observe and inspect construction as it relates to Cx, and reporting progress and deficiencies. In addition to compliance with the OPR, BoD, and Contract Documents, inspecting systems and equipment installation for adequate accessibility for maintenance and component replacement or repair.

F. Review training curriculum as developed by the contractor(s).

G. Develop detailed and specific operational and functional acceptance testing procedures for equipment and systems to be commissioned (including project-specific construction checklists).

H. Coordinate Cx meetings as necessary to facilitate the Cx process, maintain the project Cx schedule and resolve identified issues. Provide meeting notes to Cx team for review and comment.

I. Review TAB specifications, TAB plan and reports. Spot-check and witness the final TAB process.

J. Review DDC plan and reports. Spot-check and witness the DDC Point by Point checks, control programming of Seq of Ops process and Graphic interface pages at the DDC terminal. All written sequences will be functionally tested and demonstrated to the CA by the controls specialist.

K. Perform site inspections and verify contractor readiness for the operational and functional testing process. Document issues for future resolution.

L. Verify the execution of Cx process activities using random sampling. Sampling rate chosen by CA as per ASHRAE 0. Verification will include, but is not limited to, equipment submittals, construction checklists, training, operating and maintenance data, tests, and test reports to verify compliance with the OPR. When a random sample does not meet the requirement, the CA will report the failure in the issues log.

M. Prepare and maintain the Cx Observation issues log.

N. Witness contractor-performed systems, assemblies, equipment, and component startup, when possible.

O. When all items of commissioning have been successfully completed, recommend acceptance to the Owner.

P. Provide the Owner with a final Cx report to document the Cx process and to verify that the Cx process has been completed. Report shall be provided in the CA approved format for the Owner's project record (typically an electronic copy).

Q. Compile test data, inspection reports, and certificates; include them in the re-commissioning management manual (systems manual) when manual is required.

1.10 COORDINATIN AND SCHEDULING

A. Perform commissioning services to expedite the testing process and minimize unnecessary delays, while not compromising the integrity of the procedures.

B. Commissioning Agent coordinate the commissioning requirements through the A/E and Owners Representative as specified herein. A/E will coordinate the requirements from the contractors.

C. Commissioning Team: The commissioning process will require cooperation and coordination of the Contractor, subcontractors, vendors, Architect/Engineer, Commissioning Agent, and Owner.

D. Progress Meetings: Attend construction job-site meetings, as necessary, to monitor construction and commissioning progress. Coordinate with contractor to address coordination, deficiency resolution and planning issues.
   1. As soon as mobilization has occurred to the project site, the CA will conduct a pre-installation Cx "kick-off" meeting with the contractors. The CA will explain the Cx process in detail, and identify specific Cx-related responsibilities of the contractor(s).
   2. Ongoing Cx status meetings will be scheduled to occur during the construction phase to monitor progress and to help facilitate the Cx process. Contractor representatives will be required to attend these meetings. (normally tagged on to General progress site meetings).
   3. Plan and coordinate additional meetings as required to progress the work.

E. Site Observations: Perform site visits, as necessary, to observe component and system installations.
   1. Once contractors have provided the CA with written verification indicating contractor's precommissioning checklists have been completed, the CA will conduct an on-site installation inspection of the specific systems and equipment.

F. Functional Testing Coordination: Upon confirmation of system readiness, the CA will schedule with the contractors to perform operational and functional performance tests to verify functional compliance with the specifications and design intent documents.

The CA will oversee the process and will provide the format and documentation for these tests.

1. Equipment shall not be “temporarily” started for commissioning.
2. Functional performance testing shall not begin until pre-functional, start-up and TAB is completed for a given system.
3. The controls system and equipment it controls shall not be functionally tested until all points have been calibrated and pre-functional checklists are completed.
4. Issues noted during these tests will be documented on the issues log. When easily corrected, issues will be resolved at the time of discovery. All other issues will be resolved by the responsible contractor at a later time. All issues will be noted by the CA as either resolved or pending resolution. When resolved, contractor shall return communications to the CA for “re-check”.
5. The construction phase Cx process will be complete when all noted issues have been corrected, proven to comply with the contract specifications or otherwise resolved to the satisfaction of the owner.

1.11 COMMISSIONING DOCUMENTATION

A. Contractors are to provide the following information to the CA for inclusion in the commissioning plan:
   1. Submittals, systems manuals, and other documents and reports.
   2. Identification of installed systems, assemblies, equipment, and components including design changes that occurred during the construction phase.
   3. Process and schedule for completing construction checklists and manufacturer's prestart and startup checklists for HVAC&R systems, assemblies, equipment, and components to be verified and tested.
   4. Pre-functional checklists.
   5. Certificate of completion certifying that installation, prestart checks, and startup procedures have been completed.
   6. Equipment startup plans and forms.
   7. Certificate of readiness certifying that HVAC&R systems, subsystems, equipment, and associated controls are ready for testing.
   8. Test and inspection reports and certificates.
   9. Weekly Cx Status Report.
   10. Corrective action documents.
   11. Verification of testing, adjusting, and balancing reports.
   12. All other supporting documentation not specifically mentioned.

B. Record Drawings:
   1. Each Contractor shall be responsible for their section and provide Record Drawings in the required formats per the Bid Documents.
   2. Contractors shall regularly update a ‘redlined’ set of record drawings showing commissioned systems as work is being installed so that the drawings remain current with the field work.
   3. Redlining record drawings at the end of construction shall not be acceptable.

4. The Contractors in-progress redlines shall be kept on-site in the Contractor's field office and available for review by the Owner.
5. The Owner will periodically review the Contractors in-progress redline drawings for accuracy, completeness and to verify that they are being kept up-to-date.

C. Access to Contractor Documentation:
1. Contractors shall provide access to the shop drawings, coordination drawings, equipment cutsheets, schematics, in-progress record drawings, etc. to assist the Owner in execution of the Cx process.

1.12 INFORMATIONAL SUBMITTALS

A. Certificates of readiness.

B. Certificates of completion of installation, prestart, startup activities, and pre-functional testing.

1.13 CONTTRACTOR ALLOWANCES

A. Contractor to cover all costs of labor, instrumentation, tools, and equipment costs for technicians for the performance of commissioning testing.

PART 2 - PRODUCTS

2.01 TEST EQUIPMENT

A. All standard testing equipment required to perform startup and initial checkout and required pre functional tests PFT and functional acceptance tests FPT, shall be provided by the division contractor for the equipment being tested.

B. Special equipment, tools and instruments (only available from vendor, specific to a piece of equipment) required for testing equipment, to be provided according to these contract documents, shall be included in the base bid price to the Contractor.

C. All testing equipment shall be of sufficient quality and accuracy to test and/or measure system performance with the tolerances indicated in the specifications.

2.02 TEST EQUIPMENT – GENERAL

A. The Contractor party responsible for each Commissioning Procedure shall furnish all tools, equipment and instrumentation required for execution of that Procedure.

B. A list of all tools and equipment to be used during Cx shall be submitted to the Owner for review and approval prior to the start of execution.

C. Standard tools, testing equipment and instrumentation required for execution of Pre-Functional Procedures, Pre-startup Testing, Startup Procedures, and Post-startup Testing shall be provided by the Contractor responsible for the equipment being tested.

D. Testing equipment and instrumentation used for execution of Commissioning Procedures shall be of sufficient quality and accuracy to test and/or measure system performance with the tolerances specified in the Specifications. If not otherwise noted, the following minimum requirements apply:
   1. Temperature sensors and digital thermometers: certified calibration within the past year to an accuracy of 0.5˚F and a resolution of + or - 0.1˚F.
   2. Pressure sensors: accuracy of + or - 2.0% of the value range being measured (not full range of meter) and calibrated within the last year.
   3. Electrical meters (voltage, current, etc.) shall be true RMS and shall have been calibrated within the last year.
   4. Other sensors (RH, CO, CO2, etc.) shall have been calibrated within the last 6 months.

E. All test equipment and instrumentation used for Commissioning Procedures shall be calibrated according to the manufacturer's recommended intervals and when dropped or damaged.

F. Calibration tags shall be affixed or certificates readily available.

2.03 TEST EQUIMENT – SPECIAL, PROPRIETARY, OR UNIQUE

A. Equipment and software including that for testing required by any contractor, vendor or equipment manufacturer for programming, start-up, or other commissioning activity whether specified or not, shall be provided by the manufacturer of the equipment for use during commissioning and at no additional cost to the Owner.

B. Equipment, tools and instruments required for testing equipment shall be included in the base bid price to the Contractor and left on site, except for stand-alone temporary data logging equipment that may be used by the Owner.

PART 3 - EXECUTION

3.01 COMMISSIONING TEAM RESPONSIBILITIES

A. Contractor Responsibilities:

1. Review the Cx plan, milestone schedule, and functional test procedures. Provide the input required to develop final plans and procedures.
2. Contractors shall assist (along with the design engineers) in clarifying the operation and control of commissioned equipment in areas where the specifications, control drawings or equipment documentation is not sufficient for writing detailed testing procedures.
3. Provide assistance to the CA, as necessary, in preparing the specific functional acceptance test procedures as specified herein. The contractors shall review test procedures to ensure feasibility, safety and equipment protection and provide necessary written alarm limits to be used during the tests.
4. Develop a full start-up and initial checkout plan using manufacturer's start-up procedures and complete the pre-functional checklists to the CA for all commissioned equipment. During the startup and initial checkout process, execute the mechanical and electrical related portions of the pre-functional checklists for all commissioned equipment.
5. Perform and clearly document all completed startup and system operational checkout procedures, and provide a copy to the CA.
6. Address current A/E punch list and CA observation issues log items, prior to start of the functional testing. DDC Points list and sufficient programming to allow Air and Water TAB shall be completed with discrepancies and problems remedied before functional testing of the respective air- or water-related systems.
7. Provide skilled technicians to execute starting of equipment, and to execute the functional acceptance tests, as required by the CA; typically following the manufacturers' approved procedures. The CA shall develop the test procedures and orchestrate the execution of the functional testing procedures with assistance from the contractors. These procedures shall be reviewed and approved by the design team, the contractors, and the owner prior to execution. Ensure that skilled technicians are available and present during the agreed upon schedules and for sufficient duration to complete the necessary tests, adjustments and problem-solving. *The Cx procedures and functional testing do not relieve or lessen this responsibility or shift that responsibility partially to the CA or owner*.
8. Correct issues (differences between specified and observed performance) as interpreted by the CA, CM and A/E and retest the equipment.
9. Prepare O&M manuals according to the contract documents, including clarifying and updating the original sequences of operation to as-built conditions.
10. Coordinate with equipment manufacturers to determine specific requirements to maintain the validity of the warranty.
11. Execute seasonal or deferred functional performance testing, witnessed by the CA, according to the specifications.
12. Correct issues and make necessary adjustments to O&M.

B. Mechanical Contractor Responsibilities: The Cx responsibilities of the HVAC mechanical contractor(s) in addition to those listed in section 3.01.A.
   1. Coordinate installation of mechanical systems and equipment with equipment suppliers, mechanical subcontractors, and electrical contractor. Verify that coordination, installation, quality control, and final subcontractor testing have

been completed such that installed systems and equipment comply with construction documents.
2. Notify the CA and CM as soon as possible of any issues identified during construction that may affect the Cx process or final system performance.
3. Process the CA's observation issues log to the appropriate parties for timely resolution and return to CA for recheck.
4. Perform start-up and testing of mechanical equipment and systems and document as required with start-up reports and completion of contractor's pre-commissioning checklists submitted to the CA.
5. Operate equipment and systems as required for operational and functional performance testing.
6. Participate in the fine-tuning or trouble shooting of system performance if either of these measures becomes necessary.
7. Provide complete operation and maintenance information, single line schematics and as-built drawings to the general contractor for verification, organization, and distribution.

C. Electrical Contractor Responsibilities: The Cx responsibilities of the electrical contractor(s) in addition to those listed in section 3.01.A.
1. Coordinate the installation of electrical systems and equipment with equipment suppliers, electrical subcontractors, and mechanical contractor. Verify that coordination, installation, quality control, and final subcontractor testing have been completed such that installed systems and equipment comply with construction documents.
2. Notify the CA and CM immediately of any issues identified during construction that may affect the commissioning process or final system performance.
3. Perform static & dynamic tests to allow safe controlled start-up and testing of electrical system equipment and systems as required, document with start-up reports, and submit to the CA.
4. Complete and document the discrimination trip settings in conjunction with the Electrical Engineer of all breakers, fuses and safety trips prior to the commissioning functional acceptance testing.
5. Operate equipment and systems as required for functional performance testing.
6. Participate in fine-tuning or troubleshooting of system performance if either of these measures becomes necessary.
7. Provide complete operation and maintenance information, distribution board charts and as-built drawings to the general contractor for verification, organization and distribution.

D. Controls Contractor Responsibilities: The Cx responsibilities of the controls contractor(s) in addition to those listed in 3.01.A.
1. Review the Cx plan, milestone schedule, and functional test procedures. Provide the input required to develop final plans and procedures.
2. Points List, panel and P&ID control drawings and Sequences of operation submittals. The controls contractor's submittals of control drawings shall include complete detailed panel drawings and field device termination information,

sequences of operation for each piece of equipment, regardless of the completeness and clarity of the sequences in the specifications. They shall include:

a. An overview narrative of the system (one or two paragraphs) generally describing its purpose, components and function.
b. All interactions and interlocks with other systems.
c. Start-up sequences.
d. Warm-up mode sequences.
e. Normal operating mode sequences.
f. Unoccupied mode sequences.
g. Shutdown sequences.
h. Capacity control sequences and equipment staging.
i. Temperature and pressure control: setbacks, setups, resets, etc.
j. Detailed sequences for all control strategies (e.g., economizer control, optimum start/stop, staging, optimization, demand limiting, etc.).
k. Equipment startup after power failure and return to main utilities.
l. Sequences for all alarms and emergency shut downs.
m. Seasonal operational differences and recommendations.
n. Initial and recommended values for all adjustable settings, setpoints and parameters that are typically set or adjusted by operating staff; and any other control settings or fixed values, delays, etc. that will be useful during testing and operating the equipment.
o. Schedules, if known.
p. To facilitate referencing in testing procedures, all sequences shall be written in small statements, each with a number for reference. For a given system, numbers will not repeat for different sequence sections, unless the sections are numbered.

3. Control drawings submittal:
   a. The control drawings shall have a key to all abbreviations.
   b. The control drawings shall contain graphic schematic depictions of the systems and each component including wiring and termination numbers and details.
   c. The schematics will include the system controllers, device, sensors and component layout of any equipment that the control system monitors, enables or controls, even if the equipment is primarily controlled by packaged or integral controls.
   d. Provide a full points list with at least the following included for each point:
      1) Controlled system.
      2) Point abbreviation.
      3) Point description.
      4) Display unit.
      5) Control point or setpoint.
      6) Monitoring point.
      7) Intermediate point.
      8) Calculated or virtual point.

e. The controls contractor shall keep the CA informed of all changes to this list during programming and setup.

4. Complete contractor pre-commissioning checklist and other supporting documentation as required demonstrating completion of control system installation, point-to-point verification (including sensor calibration), start-up and testing, and submit to the CA.
5. Participate in PFT of mechanical equipment. Place specific systems as directed by CA into test modes for PFT.
6. Assist and cooperate with the TAB contractor in the following manner:
   a. Meet with the TAB contractor prior to beginning TAB and review the TAB plan to determine the capabilities of the control system toward completing TAB.
   b. Provide a qualified technician to operate the controls to assist the TAB contractor in performing TAB, or provide sufficient training for TAB to operate the system without assistance.
7. Assist and cooperate with the CA in the following manner:
   a. Provide a skilled technician to execute or assist in performance of the functional acceptance testing procedures of the controls system. Assist in the functional testing of all equipment specified and written sequence of operations in this section.
   b. Provide and set up control system trend logs for the points as directed by the CA.
8. Participate in fine-tuning or troubleshooting P&ID control loops of system performance if either of these measures becomes necessary.
9. Provide the CA and construction manager with final documentation for all installed conditions, including as-built drawings and detailed narrative sequences of operation and a final control programming record as determined during the Cx process.

E. TAB Contractor Responsibilities: The Cx responsibilities of the TAB contractor(s) in addition to those listed in section 3.01.A.
   1. Review the Cx plan, Cx milestone schedule, and functional test procedures. Provide the input required to develop final plans and procedures.
   2. Coordinate balancing activities with those of the mechanical and controls contractors. Verify that coordination, installation, flushing process, quality control, and final subcontractor testing have been completed to allow proper balancing work to be performed.
   3. Notify the CA, designers and construction manager as soon as possible of any system installation or performance issues that may compromise the ability of the system to be balanced.
   4. Participate in start-up and testing as required. Record duty point of all fans and pump on manufacturers performance curves for Cx & ME review and approval.
   5. Complete contractor's pre-commissioning checklist to verify completion of system balancing tasks and submit to the CA.
   6. Provide preliminary TAB report, indicating all actual field values recorded, to the CA, designer and construction manager, prior to initiation of operational and

functional testing. A preliminary TAB report shall be submitted within seven (7) working days after completion of the balancing work. If job conditions require the TAB work be divided by logical systems, the preliminary TAB report will be submitted in logical sections within seven (7) working days after completion of the balancing work on each system. Mark and permanently record all field regulating devices in the final balanced position, for readily identifiable resetting mode if needed.

7. Coordinate with CA and demonstrate verification of selected systems readings identified by the CA.
8. Assist during the operational and functional testing as required.
9. Participate in fine-tuning or troubleshooting of system performance if either of these measures becomes necessary.

3.02 COMMISSIONING PROCEDURES

A. Pre-Functional Procedures:
   1. The Pre-Functional Procedures (PFP) consists of a series of field observations conducted during the installation of commissioned equipment to verify the following:
      a. Installed equipment matches the specifications and approved submittals.
      b. Equipment is installed per the specifications, drawings and manufacturer's recommendations.
      c. Utility connections to equipment, such as electrical, steam, chilled water, etc. have been successfully completed.
      d. Equipment is ready for start-up.
   2. Complete at a minimum one (1) Pre-Functional Checklist (PFC) for each major piece of equipment covered by the commissioning process such as pumps, fans, air handling units, control panels, switchgear, substations, and electrical distribution panels. The Owner reserves the right to reject incomplete PFCs (CCs) or otherwise questionable answers and at no additional cost to the Project may cause the Contractor to resubmit and/or complete PFCs / CCs for all related components and systems for that Division.
      a. The Pre-Functional Checklists will be provided by the Owner after receipt of equipment Installation and Operation & Maintenance (IOM) Manuals from the Contractors (see paragraph entitled "Contractor Requirements" below).
      b. A copy of all completed Pre-Functional Checklists completed that week shall be forwarded to the Owner at the end of that week. The completed originals shall be maintained on-site per the requirements of this specification, paragraph entitled "Commissioning Documentation".
   3. Additional checklists will be required to verify installation of distribution systems such as piping, ductwork, electrical wire and conduit, etc. The number of required Pre-Functional Checklists will vary from system to system, but will typically be limited to one form per system per floor or zone.

B. Contractor Pre-Startup Procedures:

1. Commissioning activities and requirements related to Contractor/vendor pre-startup procedures are in addition to the testing requirements specified in other Divisions of these specifications. These do not reduce the Contractor's responsibility for successfully completing and documenting all testing requirements outlined elsewhere in these specifications.
2. The goal of these activities is to help ensure that the specified testing is rigorously executed using sound test procedures and that all tests are thoroughly documented.
3. The Contractor Pre-startup Procedures shall be documented using test forms which, at a minimum, will record the following information:
   a. Type of test or procedure being performed.
   b. System or equipment being tested.
   c. Technician(s) performing the test or procedure.
   d. Test or procedure date and time.
   e. Detailed description of section of system being tested (if applicable).
   f. All data collected during the test or procedure to quantify test performance (static and differential pressures, test duration, electrical resistance, etc.).
   g. Signature of technician(s) performing test or procedure.
   h. Signature of contractor or CA witnessing the test or procedure.
4. Contractors and vendors may use their standard testing forms; providing these forms meet the requirements outlined above and have been previously reviewed and approved by the Owner.
5. All test forms will be fully completed and maintained by the Contractor per the requirements of this specification; paragraph entitled "Commissioning Documentation".
6. All test forms will be promptly submitted to the Owner for review and acceptance upon completion of the respective test.

C. Startup Procedures:
   1. Commissioning activities and requirements related to Equipment Startup are meant to help ensure the following:
      a. Equipment installation and Pre-startup Testing has been fully completed and documented prior to startup.
      b. Startup procedures meet the equipment manufacturer's recommendations.
      c. Startup activities are fully documented.
   2. Equipment Startup requirements covered by this section of the commissioning specification include the following:
      a. All commissioned equipment requiring startup by the equipment manufacturer, vendor or representative.
      b. All rotating equipment including, but not limited to, pumps, fans, compressors, and generators.
      c. All electrical equipment including, but not limited to switchgear, substations, transformers and distribution panels.
   3. Equipment Startup Plan.
      a. Prior to Equipment Startup, the responsible Contractor shall prepare and submit a written Startup Plan which will include the following:

1) Personnel required for startup including vendors, other trades, etc.
2) Prerequisites required for startup (utility connections, PFPs, Pre-startup Testing, and other as applicable).
3) Startup procedures.
4) Forms to be used for documenting startup procedures.

b. The equipment manufacturer's standard startup procedures and forms should be used as the basis of the Contractor's Startup Plan.
c. The Owner will review the Contractor's proposed Startup Plan(s).
d. Startup of equipment shall be documented using Startup Forms, which have been previously reviewed and approved as part of the Contractor's Startup Plan.
e. All Startup Forms will be fully completed and maintained by the Contractor per the requirements of this specification paragraph entitled "Commissioning Documentation".
f. All Startup Forms will be submitted to the Owner for review and acceptance upon completion.

D. Contractor Post-Startup Testing/Procedures:
1. Commissioning activities and requirements related to Contractor Post-startup Testing / procedures are in addition to the testing / procedures requirements specified in other Divisions of these specifications. These do not reduce the Contractor's responsibility for successfully completing and documenting all testing / procedures requirements outlined elsewhere in these specifications.
2. The goal of these activities is to help ensure that the specified testing and procedures are rigorously executed using sound test procedures and that all tests are thoroughly documented.
3. Contractor Post-startup Procedure Reports:
a. The Contractor Post-startup Testing / procedures shall be documented using test forms which, at a minimum, will record the following information:
1) Type of test being performed (duct traverse, point-to-point checkout, etc.).
2) System or equipment being tested.
3) Technician(s) performing the test.
4) Test date and time.
5) Detailed description of system or section of system being tested.
6) All data collected during the test to quantify test performance (pressures, flow rates, rpm, volts, amps, temperatures, etc.).
7) Signature of technician(s) performing test.
8) Signature of Contractor or CA witnessing the test (where applicable).

b. Contractors may use their standard testing / procedures forms; providing these forms meet the requirements outlined above and have been previously reviewed and approved by the Owner.
c. All test forms will be fully completed and maintained by the Contractor per the requirements of this specification, paragraph entitled "Commissioning Documentation".
d. All test forms shall be promptly submitted to the Owner for review and acceptance.

4. General Requirements:
   a. Prior to initiating any of the Post-startup Testing / Procedures, the Contractor shall meet with the Owner to review the Contractor's proposed test procedures and test forms.
   b. The Contractor shall be responsible for successful completion and documentation of all specified Post-startup Testing / Procedures.
   c. The Owner will provide oversight to the Contractors in developing their test procedures and test.
   d. The Owner will witness selected Post-startup Tests / Procedures.
   e. Issues observed during the Contractor Post-startup Testing will be immediately reported to the GC and Owner.
   f. Contractors shall regularly update their Contractor Commissioning Process Status Tracking System.
   g. The Contractor shall furnish all tools, test equipment and instrumentation required for completion of the Post-startup Testing / Procedures. All instruments shall meet the requirements of Part 2 of this specification.
   h. The Contractor shall provide a written list of instrumentation which will be used for Poststartup Testing / Procedures indicating instrument make, model number, serial number, range, accuracy and calibration date to the Owner prior to the start of testing.
5. Test and Balance:
   a. Testing, Adjusting, and Balance Contractor (TAB) Requirements:
      1) The TAB Contractor shall be responsible for successful completion and documentation of all TAB activities specified in Section 23 05 93 – Testing, Adjusting, and Balancing for HVAC and elsewhere in these specifications as appropriate.
      2) Thirty (30) Days prior to the start of TAB activities, the TAB Contractor shall submit proposed TAB Plan (procedures and documentation) to the Owner and AE for review.
      3) After this review, and prior to start of field work, the TAB Contractor will attend one or more planning meetings as required with the Commissioning Team to review and discuss outstanding issues relating to TAB procedures and forms, discuss resolution of issues identified during the TAB Contractor's plan review and field inspections, and to coordinate field work.
      4) Prior to the start of field work, the TAB Contractor shall issue a final set of TAB procedures and TAB forms incorporating comments received from the Commissioning Team review.
      5) The TAB Contractor shall have at least one certified field technician on site whenever TAB work is being performed.
      6) The TAB Contractor shall notify the Commissioning Team a minimum of two (2) weeks in advance of the time for start of TAB work to allow the Owner and AE time to assess system readiness.
      7) The TAB Contractor shall coordinate with the controls Contractor to ensure that changes made to the control system during TAB (flow

coefficients, duct areas, etc.) are archived and become the default or initial values for these parameters.

8) The TAB Contractor shall provide daily lists of issues and/or problems identified during TAB work to the GC, Owner and AE for follow-up & resolution with the appropriate Contractors.
9) Participate in verification of the TAB report, which will consist of repeating any selected measurement contained in the TAB report where required by the Owner for sampling or diagnostic purposes.
10) TAB Contractor shall comply with the requirements listed in the Controls & Instrumentation paragraph below. The TAB Contractor shall coordinate with the controls Contractor to ensure that changes made to the control system during TAB (flow coefficients, duct areas, Temperatures, etc.) are archived and become the default or initial values for these parameters. Both Preliminary Reports for approval and final TAB Reports shall provide physical evidence of Point-to-Point Checkouts i.e.) all DDC Points commands and responses reporting properly and values reflect calibrated adjustments. Final reported values, when accepted by the Owner, will serve as Functional Testing evidence.
11) The TAB Contractor will provide technicians and instrumentation to support the field verification.
12) Failure of an item during the TAB field verification is defined as:
    1. For all readings other than sound, a deviation of more than 10 percent.
    2. For sound pressure readings, a deviation of 3 decibels. (Note: variations in background noise must be considered).
13) A failure of more than 10% of the readings tested during the field verification shall result in the rejection of the final TAB report and require re-balancing of the system(s) in question (at no additional cost to the Project or the Owner).

6. Controls and Instrumentation System Testing:
    a. Control Sequence Checkout. Contractor shall verify that the control system programming matches the specified sequences of operation. For these checkouts, the Contractor shall simulate actual operating conditions for the various operating modes being tested (heating, cooling, etc.) by false-loading systems, adjusting setpoints and similar techniques.
    b. Tune all Control Loops to obtain the fastest stable response without unreasonable hunting, offset or overshoot. Record tuning parameters and response test results for each control loop and provide trend reports to document results. Trend logs shall show both steadystate operation and response to setpoint changes.
    c. Test All Alarms and Safeties. Record all alarm parameters and alarm messages. Document all alarms and safeties have been tested and are functioning properly.
    d. Point-to-Point Checkout Requirements:
        1) These procedures will verify the following for each physical control point:
            1. Field device is installed per the manufacturer’s recommendations and the project drawings and specifications.

2. Field verify calibration of all analog inputs and outputs.
3. Verify labeling of controllers, field devices, and wiring.
4. Physical points are correctly addressed and communicating properly between its controller and the field device.

2) Detailed written procedures for execution of Point-to-Point Checkouts shall be submitted to the Owner and AE by the Contractor for review and approval prior to the start of testing. Include proposed test forms as part of this submittal.
3) The Contractor shall provide all tools and instrumentation necessary for execution of this testing. All instrumentation must be in calibration and meet the requirements of Part 2 of this specification.
4) The Owner reserves the right to field verify the Contractor's Point-to-Point Checkout testing. The Contractor shall provide the technicians and instrumentation used for the original testing to assist the Owner with this field verification.

E. FTP Procedures:
1. Functional Test Plan (FTP) Procedures are executed after commissioned equipment and systems have been installed, started-up and balanced. The goal of these procedures is to verify that commissioned equipment, sub-systems and major systems operate and perform per the design intent and the project specifications.
2. The role of the Owner is to witness FTPs by documenting the performance. During this phase of Construction the systems are to have been fully contractor verified through all sequences and operations normal to the Project. The Owner is not responsible to help resolve non-performance and/or operating issues etc.
3. Equipment-level FTPs will be used to verify operation and capacity of selected equipment such as boilers, chillers cooling towers, pumps, exhaust fans, air handling units, etc.
4. System-level FTPs will verify the following aspects of system operation:
   a. System operation under both normal and alternate operating conditions and modes.
   b. Interactions between equipment and sub-systems.
   c. Operation of safeties and interlocks.
   d. Control system operation, response time, stability and tuning.
   e. System response to abnormal and/or emergency conditions such as fire, equipment failure and power outages.

F. Issue Resolution Procedures:
1. The Owner will maintain and periodically publish a separate Issue Log (LOG), which will be used to document issues identified during the commissioning process. This LOG will track the following information for each identified issue:
   a. Date issue was identified.
   b. Issue priority (high, intermediate, low).
   c. Party responsible for issue resolution.
   d. Issue description.

e. Actions taken to resolve issue.
f. Issue status (open, closed).
g. Date issue was resolved.

2. The Contractor(s) shall promptly respond to the LOG in writing concerning the status of each open issue identified as their responsibility during execution of the commissioning process. Contractor responses shall include the following information as appropriate:
   a. Explanations of any disagreements.
   b. Actions taken to resolve issue.
   c. Proposed actions including completion dates.
3. The Prime Contractors, including their Sub-Contractors, vendors and suppliers are responsible for resolution of all issues identified during execution of the commissioning process.
4. Issues shall be resolved in a timely manner, typically within 72 hours of notification, to avoid impact to either the construction schedule or commissioning schedule.
5. Only the CA can close an issue.
6. Failure Due to Manufacturer Defect:
   a. If similar types of equipment from one manufacturer or supplier fail to perform to the Contract Documents (mechanically or substantively) due to manufacturing, handling, or similar defect, not allowing it to meet its submitted performance spec, all similar units may be considered unacceptable by the AE or Owner. In such case, the Contractor(s) shall provide the Owner with the following:
      1) Within one week of notification from the AE or Owner, the Contractor shall cause the manufacturer's representative to examine other identical units making a record of the findings. The findings shall be provided to the AE and Owner within two weeks of the original notice.
      2) Within two weeks of the original notification, the manufacturer, through the Contractor, shall provide a signed and dated, written explanation of the issue, cause of failures, etc. and all proposed solutions, which shall include full equipment submittals. The proposed solutions shall not significantly exceed the specification requirements of the original installation.
   b. The AE and Owner will determine whether a replacement of all identical units or a repair is acceptable.
   c. Sufficient examples to allow adequate evaluation of the proposed solution will be installed by the Contractor. The Owner and AE will determine the performance prior to deciding whether to accept the solution.
   d. After such procedures are performed and the results have been accepted as noted above, the Contractor and/or manufacturer shall replace or repair all identical items, at their expense and extend the warranty accordingly.

G. Short-Term Diagnostic Testing:
   1. Short-Term Diagnostic Testing: After initial occupancy, perform short-term diagnostic testing, using data acquisition equipment to record system operation over a two to three week period.

a. Investigate the dynamic interactions between components in the building system.
b. Evaluate the scheduling, the interaction between heating and cooling, and the effectiveness of the HVAC system in meeting the comfort requirements.

H. Operation and Maintenance Manuals:
1. The Contractor shall provide the Owner with comprehensive, project-specific manuals for the safe and effective Operation and Maintenance (O&M) of the systems and equipment listed, in this specification.
2. O&M Manual requirements included in other Sections of this Specification are in addition to, and do not replace, those required in this Section.
3. Provide (1) complete Electronic Set to the Owner. The format shall be PDF, and / or MS Word, MS Excel, MS Project. On CDRom, or USB 2.0 drive, or DVD readable on Ms Office 2010.
4. PDF manual shall be indexed to allow navigation from table of contents to sections of the manual.
5. As part of the Commissioning documentation, provide the following material:
   a. Each chapter shall contain the following information in addition to the requirements specified elsewhere in these specifications.
      1) Contact list identifying vendors providing equipment and systems covered in the current chapter. This information shall include vendor name, address, name of contact person(s), phone numbers (including 24 hour service numbers where appropriate), fax numbers, and email addresses.
      2) Equipment/material schedule(s) for all covered equipment and systems showing equipment identification (tag) number, manufacturer, model number, serial number, quantities, area/system served, equipment location, etc.
   b. References shall be made, as appropriate, to drawings, schematics, sequences of operation and other information included as part of the construction contract drawings and specifications that show distribution system layout, equipment arrangements and items of control.
   c. All information included in the final O&M Manuals, including equipment schedules, manufacturer's literature, drawings, etc. shall represent the "as-built" condition.
   d. Manufacturer's literature and other information provided in the O&M Manuals shall be for the actual equipment installed under contract for the particular facility. Where literature (standard product catalogs, cut-sheets, etc.) contains data pertaining to parts, equipment or options other than those specifically provided for this project, the Contractor shall clearly indicate the specific products, model numbers, and options provided. Mark-ups made by the Contractor for this purpose shall be made in a manner that will clearly photocopy (no highlighters).
   e. Each chapter shall include the information required in the appropriate section of the specifications plus any additional information necessary for the Owner's personnel to successfully operate and maintain the systems and equipment covered in that chapter.

f. Information to be provided in the Operation and Maintenance Manuals includes the following.
   1) Warranty information:
      1. Provide copies of all warranty certificates from equipment manufacturers.
      2. If not included on warranty certificate, provide the start/end dates of warranty period, descriptions of what is and isn't covered and contact information for warranty claims (if different from contact list described above).
      3. Provide information of an operations or maintenance nature covering warranty items that have not been discussed elsewhere.
   2) Product Information:
      1. Provide manufacturers' standard, published product literature describing covered materials, equipment and devices including illustrations, exploded views, dimensions, weights, application data, etc.
      2. Where manufacturer's product information (catalog cut-sheets, etc.) contain data pertaining to parts, equipment or options other than those specifically provided for this project, the Contractor shall clearly indicate the specific products, model numbers, and options provided. Mark-ups made by the Contractor for this purpose shall be made in a manner that will clearly photocopy (no highlighters).
      3. Provide manufacturer's standard, published Installation, Operation & Maintenance bulletins pertaining to the specific equipment installed.
      4. Provide performance curves and rating data, specific to the equipment installed on the project such as fan and pump curves, chiller selection sheets, sound data, etc.
      5. Provide a copy of all approved shop drawings covering approval of equipment for the project with the product information.
      6. Include all data concerning changes made during construction.
   3) Preventive Maintenance Procedures & Schedules:
      1. Provide written preventive maintenance procedures describing each required PM task.
      2. Procedures shall include lists of tools and parts required and all safety precautions to be taken.
      3. State, preferably in tabular form, the recommended frequency for each preventive maintenance task (cleaning, inspection, lubrication, scheduled overhauls, etc.). Task schedules shall be grouped and sorted by frequency (daily, weekly, quarterly, annually, etc.).
      4. Procedures for lubrication of equipment shall indicate both the type and quantity of lubricant to be used.
         a. If periodic inspection of equipment is required for operation, cleaning, or other reasons, indicate the items to be inspected and give the inspection criteria.

b. Provide instruction for the proper handling, disposal and/or removal of hazardous or otherwise special materials such as used filters, refrigerant, oils, chemicals, etc.
c. Provide instruction for minor repairs or adjustments required for preventive maintenance routines. Minor repair and adjustment shall be limited to repairs and adjustments that may be performed without special tools or test equipment and that require no special training or skills. Identify test points and give values for each.

4) Corrective Maintenance Procedures:
   1. Corrective Maintenance: Corrective maintenance instructions shall be predicated upon a logical effect-to-cause troubleshooting philosophy and a rapid replacement procedure to minimize equipment downtime. Instructions and data shall appear in the normal sequence of corrective maintenance, for example, troubleshooting first, repair and replacement of parts second, and then the parts list..
   2. Troubleshooting: This information shall describe the general procedure for locating malfunctions and shall give, in detail, any specific remedial procedures or techniques. The data shown are intended to isolate only the most common equipment deficiencies. Troubleshooting tables, charts, or diagrams may be used to present specific procedures. A guide to this type shall be a three-column chart. The columns shall be entitled Malfunction, Probable Cause, and Recommended Action. The information shall be alphabetically arranged by component, and each component shall, in turn, list deficiencies that may be expected. Each deficiency shall contain one or more problems with a recommended correction.
   3. Repair and Replacement: Indicate the repair and replacement procedures most likely to be required in the maintenance of the systems and equipment. Information included here shall consist of step-by-step instructions for repair and replacement of defective items. Include all information required to accomplish repair or replacement, including information such as torque values. Identify all tools, special equipment, and materials that may be required. Identify uses for maintenance equipment. The paragraphs shall contain headings to identify the topics covered.
5) Spare Parts Lists:
   1. Provide a list of all spare parts for the covered equipment. The parts list shall include a tabulation of descriptive data for each part including part number and manufacturer. Where available, provide an exploded diagram of the equipment identifying parts listed in the spare parts list.
   2. Provide a list of recommended spare parts to be kept in inventory by the Owner’s maintenance staff for performance of preventive maintenance and typical corrective maintenance tasks.
6) System Descriptions:
   1. Provide a typewritten narrative describing, in general terms, the covered equipment / system. Topics to be covered in this narrative

shall include theory of operation, overall system layout, description of major components, interconnections with utilities and other systems, description of control system layout and operation, identification of unusual features or functions, and major safety precautions. This information should correlate with information provided in the manufacturers' standard published literature.

2. Provide a list of recommended spare parts to be kept in inventory by the Owner's maintenance staff for performance of preventive maintenance and typical corrective maintenance tasks.
    a. Detailed illustrations and schematic diagrams of each system showing major components, piping, valves, controls, utility connections, and other components, where applicable.
    b. Wiring and control diagrams with data to explain detailed operation and control of each component.
    c. Control sequences describing start-up, all modes of operation, and shut down.
    d. Corrected shop drawings.
    e. Copies of approved certifications and laboratory test reports (where applicable).

7) Operating Instructions:
    1. Provide condensed, typewritten, instructions for operation of the covered systems and equipment. Where more than one (1) common unit is installed, one set of instructions is adequate. The instructions shall provide procedures for:
        a. Starting up the equipment/system.
        b. Shutting down the equipment/system.
        c. Normal operating procedures.
        d. Procedures for operating the equipment / system in emergency or unusual conditions.
        e. Safety precautions.
        f. Procedures for both short-term and long-term equipment layup.
        g. Other pertinent data applicable to the operation of particular systems or equipment.
        h. The instructions shall be suitable for posting adjacent to the equipment.
8) Factory Test Reports:
    1. Provide copies of factory test reports specified in the covered section of the specifications.
    2. Test reports should include a brief description of the test procedures used, test date, names of personnel performing test, names of personnel witnessing test (if any), test results and comparison of test results with specified acceptance criteria.
9) Field Test Reports;
    1. Provide copies of field test reports specified in the covered section of the specifications. Samples of field testing include, but are not limited

to, leak testing of piping and ductwork and megger testing of electrical distribution systems.

I. Operation and Maintenance Training:
   1. The Contractor shall train the Owner's personnel in the operation and maintenance of systems and equipment listed in this Section and as mentioned in other sections.
   2. The required training and demonstration required in the technical sections of the specifications is supplemental or in addition to the training required in this Section (where not a duplication).
   3. Training agenda to be approved in writing by the owner and CA prior to training.

J. Acceptance:
   1. Satisfactory completion and documentation of the Commissioning Activities described in this specification shall be considered prerequisites for system acceptance.
   2. At no time will acceptance be made for individual pieces of equipment. Final acceptance will only be for systems that will operate as intended in the basis of design and the design intent.

END OF SECTION

SECTION 03 30 00
CAST-IN-PLACE CONCRETE

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 specifies cast-in place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:
   1. Footings.
   2. Foundation walls.
   3. Slabs-on-grade.
   4. Equipment pads and bases inside the building.
   5. Vapor retarder loose laid under slabs on grade.
   6. Placing of insulation under slabs on grade.
   7. Installation of semirigid joint filler in saw-cut control joints in the slab on grade.

B. Related Sections include the following:
   1. Section 07 21 00 “Building Insulation” for underslab insulation.
   2. Section 31 20 00 "Earth Moving" for base course material under slabs-on-grade.

1.03 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.

1.04 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Design Mixtures: At least 30 days prior to start of work, submit mix for each concrete mixture. Do not begin concrete production until proposed mix designs have been reviewed by the Architect. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments. Include what the mix will be used for and include method of placement (chute, pump, etc.)
   1. Indicate amounts of mixing water to be withheld for later addition at Project site.

C. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.

D. Samples: As requested by the Architect.

E. Qualification Data: For manufacturer.

F. Material Certificates: For each of the following:
1. Cementitious materials.
2. Admixtures.
3. Waterstops.
4. Curing compounds.
5. Bonding agents.
6. Adhesives.
7. Vapor retarders.
8. Semirigid joint filler.
9. Joint-filler strips.
10. Repair materials.

G. Minutes of preinstallation conference.

1.05 QUALITY ASSURANCE

A. It is the intent of the Drawings and Specifications to produce concrete which will have the required strength and appearance. Failure to comply with these requirements will require removal of sufficiently large portions of the work, as determined by the Architect, in order to properly integrate the portions to be replaced with the architectural and structural requirements of the total project. All such removal and replacement shall be made at the expense of the Contractor at no additional cost to the Owner.

B. Coordinate concrete work with all related work which requires items to be inserted in the forms and cast in the concrete, regardless of whether such inserted items are specifically described in the Contract Documents.

C. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.

D. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated, as documented according to ASTM E 548.
1. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.

E. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from one source, and obtain admixtures through one source from a single manufacturer.

F. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
1. ACI 301, "Specification for Structural Concrete," Sections 1 through 5.
2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

G. Where concrete volumes of over 100 cubic yards contain high-range water reducer or non-chloride accelerator, a qualified manufacturer's representative shall observe job start-up concrete placements.

H. Execute work under specified temperature conditions. Post thermometers at locations of work.

I. Preinstallation Conference: At least 15 days prior to the start of the concrete construction, conduct conference at Project site to comply with requirements in Section 01 31 00 "Project Management and Coordination."
   1. Discuss the required methods and procedures to achieve the required quality construction. Review requirements for submittals, status of coordinating work, and availability of materials. Establish preliminary work progress schedule, Contractor's quality control procedures and procedures for materials inspection, testing, and certifications. Review concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, construction contraction and isolation joints, and joint-filler strips, semirigid joint fillers, forms and form removal limitations, vapor-retarder installation, anchor rod and anchorage device installation tolerances, steel reinforcement installation, floor and slab flatness and levelness measurement, concrete repair procedures, and concrete protection.
   2. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
      a. Contractor's superintendent.
      b. Independent testing agency responsible for concrete design mixtures.
      c. Ready-mix concrete manufacturer.
      d. Concrete subcontractor(s), including foremen who will be directing the installation of the reinforcing steel and the placement and finishing of the concrete.
      e. Owner's Special independent testing and inspection agency, including the specific individual(s) who will be performing the work.
      f. Architect and, where applicable, the Owner's representative.
   3. Do not conduct the meeting unless all representatives are present – reschedule the meeting as required

1.06 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.

B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

PART 2 - PRODUCTS

2.01 FORM-FACING MATERIALS

A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
   1. Plywood, metal, or other approved panel materials.

B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.

C. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch (19 by 19 mm), minimum.

D. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.

E. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
1. Formulate form-release agent with rust inhibitor for steel form-facing materials.

F. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
1. Furnish units that will leave no corrodible metal closer than 1-1/2 inches (38 mm) to the plane of exposed concrete surface.
2. Furnish ties that, when removed, will leave no holes in concrete surface.
3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

2.02 STEEL REINFORCEMENT

A. Reinforcing steel shall be bundled and tagged with grades and suitable identification marks for checking, sorting, and placing. Tags and markings shall be waterproof and shall not be removed until steel is placed.

B. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.

C. Steel Bar Mats: ASTM A 184/A 184M, fabricated from ASTM A 615/A 615M, Grade 60 (Grade 420), deformed bars, assembled with clips.

D. Plain-Steel Wire: ASTM A 82, as drawn.

E. Deformed-Steel Wire: ASTM A 496.

F. Plain-Steel Welded Wire Reinforcement: ASTM A 185, plain, fabricated from as-drawn steel wire into flat sheets.

G. Deformed-Steel Welded Wire Reinforcement: ASTM A 497, flat sheet.

2.03 REINFORCEMENT ACCESSORIES

A. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), plain-steel bars, cut bars true to length with ends square and free of burrs.

B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:

1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.

2.04 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
   1. Portland Cement: ASTM C 150, Type I/II, gray. Use Type II cement for slab concrete. At contractor's option, supplement with the following:
      a. Fly Ash: ASTM C 618, Class F.
      b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.

B. Normal-Weight Aggregates: ASTM C 33, Class 4S coarse aggregate or better, graded. Provide aggregates from a single source.
   1. Maximum Nominal Coarse-Aggregate Size:
      a. Footings: 1-1/2 inches (38 mm) nominal.
      b. Foundation walls: 3/4 inch (19 mm) nominal.
      c. Slabs-on-grade placed by chute or bucket: 1-1/2 inches (38 mm) nominal.
      d. Slabs-on-grade placed by pump: 1 inch (25 mm) nominal.
      e. Equipment pads: 3/4 inch (19 mm) nominal.
   2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

C. Water: ASTM C 94/C 94M and potable.

2.05 ADMIXTURES

A. Air-Entraining Admixture: ASTM C 260, certified by manufacturer to be compatible with other required admixtures. Subject to compliance with requirements, provide one of the following:
   1. "Air-Mix," Euclid Chemical Co.
   2. "Darex AEA" or "Daravair," W.R. Grace & Co.
   3. "MB-VR" or "Micro-Air," Master Builders, Inc.
   4. "Sika AER," Sika Corp.

B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete and contain not more than 0.05% chloride ions. Do not use calcium chloride or admixtures containing calcium chloride.

C. Water-Reducing Admixture: ASTM C 494/C 494M, Type A. Subject to compliance with requirements, provide one of the following:
   1. "Eucon WR-75 or 89," Euclid Chemical Co.
   2. "WRDA w/ Hycol," W.R. Grace & Co.
   3. "Pozzolith Normal" or "Polyheed," Master Builders, Inc.
   4. "Plastocrete 161," Sika Corp.

D. Retarding Admixture: ASTM C 494/C 494M, Type B.

E. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D. Subject to compliance with requirements, provide one of the following:
   1. "Eucon Retarder 75," Euclid Chemical Co.

2. "Daratard-17," W.R. Grace & Co.
3. "Pozzolith R," Master Builders, Inc.
4. "Plastiment," Sika Corporation.

F. Mid-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type A. Subject to compliance with requirements, provide one of the following:
1. "MIRA-70," W.R. Grace & Co.
2. Mid-Range Water Reducer, Master Builders, Inc.

G. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F. Subject to compliance with requirements, provide one of the following:
1. "Eucon 37," Euclid Chemical Co.
2. "ADVA," W.R. Grace & Co.
3. "Rheobuild 1000," Master Builders, Inc.

H. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G. Subject to compliance with requirements, provide one of the following:
1. "Eucon 537," Euclid Chemical Co.
2. "Daracem 100," W.R. Grace & Co.
3. "Rheobuild 716," Master Builders, Inc.

I. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

J. Non-Corrosive, Non-Chloride Accelerator: ASTM C 494/C 494M, Type C or E. Admixture shall not contain more chloride ions than are present in municipal drinking water. The admixture manufacturer must have long-term non-corrosive test data from an independent testing laboratory (of at least a year's duration) using an acceptable accelerated corrosion test method such as that using electrical potential measures. Subject to compliance with requirements, provide one of the following:
1. "Accelguard 80," Euclid Chemical Co.
2. "Polarset," W.R. Grace & Co.

K. Concrete Water Mitigation Admixture meeting ASTM specifications C494, D5084, E1643, and E 1745, shall be used in all slabs on grade. Subject to compliance with requirements, provide one of the following:
1. "Barrier 1," Barrier 1 Inc.
2. "Moxie 1800 Super Admix," Moxie International.
3. "Vapor Lock 20/20," Specialty Products Group.

2.06 WATERSTOPS

A. Self-Expanding Butyl Strip Waterstops: Manufactured rectangular or trapezoidal strip, butyl rubber with sodium bentonite or other hydrophilic polymers, for adhesive bonding to concrete, 3/4 by 1 inch (19 by 25 mm).
1. Products:
   a. Volclay "Waterstop-RX," Colloid Environmental Technologies Company.
   b. "Swellstop," Greenstreak.

2.07 VAPOR RETARDERS

A. Plastic Vapor Retarder: ASTM E 1745, Class A, with maximum permeance rating of 0.02 perm after conditioning. Include manufacturer's recommended adhesive or pressure-sensitive tape.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Stego Industries, LLC; Stego Wrap 15-mil.
      b. Fortifiber Corporation; Moistop Ultra 15.
      c. Raven Industries, VaporBlock 15.
      d. Reef Industries, Inc.; Griffolyn 15 mil Green.

2.08 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) when dry.

C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

D. Water: Potable.

E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating, certified by curing compound manufacturer to not interfere with bonding of floor covering.
   1. In addition to manufacturer’s certification, provide evidence of compatibility with floor finishes shall be in the form of one of the following:
      a. Successful adhesion tests conducted with samples of the flooring system on a test slab cured with the compound and written acceptance of the test results by the flooring contractor.
      b. Written documentation from the flooring contractor accepting the compound as compatible with the flooring system.

F. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A. “Super Diamond Clear VOX” by The Euclid Chemical Company or approved equal.

2.09 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber. Premolded, of sizes and thicknesses shown on drawings.

B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 or aromatic polyurea with a Type A shore durometer hardness range of 90 to 95 per ASTM D 2240. Subject to compliance with requirements, provide one of the following:
   1. "MM-80," Metzger/McGuire.
   2. "Euco 700," Euclid Chemical Company.
   3. "Sikadur 51 SL," Sika Corporation.

C. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene. Subject to compliance with requirements, provide one of the following:
   1. "SBR Latex" or "Flex-Con," Euclid Chemical Co.
   2. "Daraweld C," W.R. Grace & Co.
   3. "Sonocrete," Sonneborn-Rexnord.

D. Epoxy Bonding Agent: "Armatec 110," Sika Corporation.

E. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:
   1. Types I and II (for non-load bearing conditions) and types IV and V (for load bearing conditions) for bonding hardened or freshly mixed concrete to hardened concrete.
   2. Subject to compliance with requirements, provide one of the following:
      a. "Euco Epoxy System #452 MV or #620," Euclid Chemical Co.
      b. "Epoxtite Binder 2390," A.C. Horn, Inc.
      c. "Sikadur 32 Hi-Mod," Sika Corp.

F. Epoxy Anchors: Hilti HIT HY-200 Safe-Set anchors, or approved equal.

2.10 REPAIR MATERIALS

A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch (3.2 mm) and that can be feathered at edges to match adjacent floor elevations.
   1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
   2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
   3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch (3.2 to 6 mm) or coarse sand as recommended by underlayment manufacturer.
   4. Compressive Strength: Not less than 4100 psi (29 MPa) at 28 days when tested according to ASTM C 109/C 109M.

B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch (3.2 mm) and that can be feathered at edges to match adjacent floor elevations.
   1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
   2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
   3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch (3.2 to 6 mm) or coarse sand as recommended by topping manufacturer.
   4. Compressive Strength: Not less than 5000 psi (34.5 MPa) at 28 days when tested according to ASTM C 109/C 109M.

2.11 CONCRETE MIXTURES, GENERAL

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301. The design of the exact

proportions for the mix, including amounts of admixtures and water to meet all specification requirements shall be the responsibility of the concrete supplier.

1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.

B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
   1. Fly Ash: 25 percent.
   2. Ground Granulated Blast-Furnace Slag: 50 percent.
   3. Combined Fly Ash and Ground Granulated Blast-Furnace Slag: 50 percent portland cement minimum, with fly ash not exceeding 25 percent.

C. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.

D. Admixtures: Use admixtures according to manufacturer's written instructions.
   1. Use mid-range or high-range water-reducing admixture (Superplasticizer) in concrete as required for placement and workability.
      a. Use mid-range water-reducing admixture in pumped concrete, concrete for slabs, and concrete with water/cement ratio of 0.50 or less.
      b. Use high-range water-reducing admixture in concrete required to be watertight and concrete with water/cement ratio of 0.40 or less.
   2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
   3. Use nonchloride accelerating admixture in concrete slabs placed at ambient temperatures below 50°F (10°C).
   4. Use air-entraining admixture in exterior exposed concrete unless otherwise indicated. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having total air content of 4.5 to 6.5 percent. Interior slabs shall have a maximum air content of 3 percent.
   5. Use water mitigation admixture in all slabs on grade in accordance with the manufacturer’s recommendations.

E. Water-Cement Ratio: Provide concrete for following conditions with maximum water-cement (W/C) ratios as follows:
   1. Reinforced concrete subjected to brackish water, salt spray, deicers, or to be watertight; W/C 0.40.
   2. Subjected to freezing and thawing; W/C 0.45.
   3. Interior slabs: W/C 0.50.
   4. All other concrete; W/C 0.58.

   The water-cement ratio is to be calculated based on the following cementitious content or the actual cementitious content used in the mix, whichever is less.

   f’c = 4000 psi.: 611 pounds per cubic yard.
   f’c = 3500 psi.: 540 pounds per cubic yard.
   f’c = 3000 psi.: 470 pounds per cubic yard.

F. Slump Limits: Proportion and design mixes to result in concrete slump at point of placement as follows:
   1. Ramps, slabs, and sloping surfaces: Not more than 3 inches.
   2. Reinforced foundation systems: Not less than 1 inch and not more than 3 inches.

3. Concrete containing plant-added mid-range water reducing admixture: 4 inch to 6 inch slump at time of arrival at the site.
4. Concrete containing high-range water-reducing admixture (Superplasticizer): Not more than 8 inches after addition of high-range water-reducing to site-verified 2-inch to 3-inch slump concrete . Concrete containing plant added high-range water-reducing admixture shall arrive at the site with a 5 inch to 8 inch slump.
5. Other concrete: Not more than 4 inches.

2.12 CONCRETE MIXTURES FOR BUILDING ELEMENTS

A. Footings: Normal weight concrete with a minimum compressive strength: 4000 psi (27.6 MPa) at 28 days.

B. Foundation Walls: Normal weight concrete with a minimum compressive strength: 4000 psi (27.6 MPa) at 28 days.

C. Slabs-on-Grade: Normal weight concrete with a minimum compressive strength: 4000 psi (27.6 MPa) at 28 days.

D. Interior Equipment Pads: Normal weight concrete with a minimum compressive strength: 4000 psi (27.6 MPa) at 28 days.

2.13 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.14 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M, and furnish batch ticket information.
1. In the event concrete is mixed at a central batching plant, arrange the delivery so that intervals between batches are kept to a minimum, and in any event not more than 30 minutes. Trucks shall be in first class condition and kept in constant rotation during delivery.
2. When air temperature is between 85 and 90 deg F (30 and 32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.
3. Use no admixtures, except those specified, without specific approval of the Architect. Admixtures containing calcium chloride will not be permitted.
4. Use admixtures in strict accordance with the directions of the manufacturer and in accurate proportions. Dispense the mid-range water-reducing and air entraining admixtures at the ready-mix plant. Dispense the high-range water-reducing admixture (superplasticizer) either from truck mounted tanks at the jobsite or at the ready-mix plant, at Contractor's option. Mix 70 revolutions or 5 minutes to assure a consistent mixture.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Before placing concrete for footings or slabs cast on grade, in the company of the concrete installer inspect the subgrade, and inspect insulation and vapor barrier, and confirm that these substrates have been properly prepared; that sub-slab insulation is firmly supported, and that the vapor barrier is continuous, complete in its coverage, and undamaged.

B. If non-conforming work is observed, require the trade responsible for the original installation of that work to correct it. Do not proceed with placement of concrete until unsatisfactory conditions have been corrected.

3.02 FORMWORK

A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.

B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.

C. Limit concrete surface irregularities, designated by ACI 347R as abrupt or gradual, as follows:
1. Class A, 1/8 inch (3.2 mm) for smooth-formed finished surfaces.
2. Class B, 1/4 inch (6 mm) for rough-formed finished surfaces.

D. Construct forms tight enough to prevent loss of concrete mortar.

E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
1. Install keyways, recesses, and the like, for easy removal.
2. Do not use rust-stained steel form-facing material.

F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.

G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.

H. Chamfer exterior corners and edges of permanently exposed concrete.

I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.

J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.03 EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."

B. Do not embed electrical and telephone conduit runs larger than 3/4 inch diameter in wall or slab-on-grade concrete. One layer of 3/4 inch diameter or smaller conduit may be run in concrete walls or concrete slabs on-grade provided that parallel runs are spaced a minimum of 12 inches apart. Do not embed conduit runs of any size in elevated concrete slabs. Do not install aluminum conduit in any concrete.

3.04 REMOVING AND REUSING FORMS

A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F (10 deg C) for 24 hours after placing concrete, if concrete is hard enough to not be damaged by form-removal operations and curing and protection operations are maintained.

B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.

C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.05 UNDERSLAB INSULATION

A. Preparation: Before placing under-slab insulation, confirm that top surface of the granular base course material placed under Section 31 20 00, Earth Moving, is well compacted and level to within 1/4” of the required grade and flat to within 1/4” of a 10 foot long straight edge. If necessary, require earthwork subcontractor to add a 2” layer of sand, conforming to specifications in Section 31 20 00, Earth Moving, fine granular material, on top of the granular base course in order to achieve the required grade.

B. Place a layer of extruded polystyrene insulation boards on top of the compacted, leveled base course. As installation progresses, check to make certain there are no voids below the insulation; in non-conforming areas, add sand, regrade, and recompact the top surface of the base course to provide continuous, solid bearing under the insulation. Stagger end joints and

tightly abut insulation units. Cut insulation as required at floor penetrations, at locations of hangers for underslab utilities, and at sloped floor conditions.

3.06 VAPOR RETARDERS

A. Plastic Vapor Retarder: Place, protect, and repair vapor retarders according to ASTM E 1643 and manufacturer's written instructions, and as follows:
   1. Place vapor retarder/barrier sheeting on top of the insulation with longest dimension parallel with direction of pour.
   2. Lap joints 6 inches and seal joints with manufacturers' recommended mastic and/or pressure-sensitive tape.
   3. Extend vapor retarder/barrier a minimum of 12” down the sides of perimeter walls, grade beams, and other vertical elements below the slab by providing a separate strip of material (with an extended flap for lapping with the horizontal sheet) inside the vertical forms during the placement of the vertical element.
   4. Lap and seal the perimeter edges in accordance with the manufacturer’s recommendations. Keep surface clean of materials that would prevent a bond with the concrete slab.

B. Be careful not to damage or puncture the vapor retarder/barrier while placing reinforcement or pouring concrete. Repair or replace damaged areas immediately before pouring concrete.

3.07 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
   1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.

C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover.
   1. Slabs Cast on Grade: Provide supports for reinforcing bars or welded wire fabric at 3’-0” maximum o.c. each way.

D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

E. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

3.08 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.

1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints, unless otherwise indicated.
2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches (38 mm) into concrete.
3. Locate horizontal joints in walls and columns at underside of floors, slabs, and at the top of footings or floor slabs.
4. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
5. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. If joint pattern is not shown, provide joints in slabs-on-grade not exceeding 15 feet in either direction and located to conform to bay spacing wherever possible (at column centerlines, half bays, third bays). Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:
1. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- (3.2-mm-) wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks. Provide wider joints as required for placement of joint filler materials such as sealants and semirigid joint materials.

D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface, unless otherwise indicated.
2. Terminate full-width joint-filler strips not less than 1/2 inch (13 mm) or more than 1 inch (25 mm) below finished concrete surface where joint sealants, specified in Section 07 92 00 "Joint Sealants," are indicated.
3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

E. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

3.09 WATERSTOPS

A. Self-Expanding Strip Waterstops: Install in construction joints and at other locations indicated, according to manufacturer's written instructions, adhesive bonding, mechanically fastening, and firmly pressing into place. Install in longest lengths practicable.

3.10 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed. Notify the Architect and Owner’s Special inspection/testing agency at least 24 hours in advance of the placing of any concrete.

B. Soil bottoms for footings and slabs must be approved by the Owner’s Special Testing and Inspection Agency before placing concrete.

C. Remove water from place of deposit before concrete is placed unless otherwise permitted by the Architect. Divert all flow of water into an excavation through proper side drains into a sump, or remove it by other approved methods.

D. Lightly dampen soil onto which concrete will be placed, except in freezing weather, without softening the properly prepared bearing material.

E. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect, and only up to the amount allowed in approved design mix.
   1. Where approved, add water before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.
   2. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

F. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
   1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
   2. Do not freely drop concrete where reinforcement will cause segregation, nor more than 6 feet. Place concrete to maintain a plastic surface approximately horizontal, and not more than 3 feet deep. Use tremies for concrete placement over 6 feet high.
   3. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
   4. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches (150 mm) into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

G. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
   1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
   2. Maintain reinforcement in position on chairs during concrete placement.
   3. Screed slab surfaces with a straightedge and strike off to correct elevations.
   4. Slope surfaces uniformly to drains where required.
   5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

H. Pumping concrete: Concrete may be placed by pumping if first approved in writing by the Architect for the location proposed.
   1. Equipment: Use pumping equipment of such size and design that ensures a practically continuous flow of concrete at the delivery end without separation of materials. Do not pump concrete through aluminum pipes.
   2. Concrete Mix: Design concrete mix to the requirements specified, except that mix may be richer in lubricating components in order to allow proper pumping. Include the specified high-range or mid-range water reducing admixture in the mix.

I. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
   1. When average high and low temperature is expected to fall below 40 deg F (4.4 deg C) for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
   2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
   3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

J. Hot-Weather Placement: Comply with ACI 301 and as follows:
   1. Maintain concrete temperature below 90 deg F (32 deg C) at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
   2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

3.11 FINISHING FORMED SURFACES

A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
   1. Apply to concrete surfaces not exposed to public view.

B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
   1. Apply to concrete surfaces exposed to public view or to be covered with a coating or covering material applied directly to concrete.

C. Rubbed Finish: Apply the following to smooth-formed finished as-cast concrete surfaces exposed to public view.
   1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.

D. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

3.12 FINISHING FLOORS AND SLABS

A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture.
   1. Apply float finish to surfaces to receive trowel finish.

C. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
   1. Apply a trowel finish to surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
   2. Finish and measure surface so gap at any point between concrete surface and an unleveled, freestanding, 10-foot- (3.05-m-) long straightedge resting on 2 high spots and placed anywhere on the surface does not exceed 3/16 inch (4.8 mm).

D. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces where ceramic or quarry tile is to be installed by either thickset or thin-set method. While concrete is still plastic, slightly scarify surface with a fine broom.
   1. Comply with flatness and levelness tolerances for trowel finished floor surfaces.

3.13 MISCELLANEOUS CONCRETE ITEMS

A. Filling In: Fill in holes and openings left in concrete structures, unless otherwise indicated, after work of other trades is in place. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.

B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates from manufacturer furnishing machines and equipment.

D. Grouting: Grout all column base plates, equipment bases and other locations noted on the structural drawings with the specified non-shrink, non-metallic grout.

3.14 CONCRETE PROTECTING AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.
   1. Start initial curing as soon as free water has disappeared from concrete surface after placing and finishing. Weather permitting, keep continuously moist for not less than 7 days.

B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h (1 kg/sq. m x h) before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. Formed Surfaces: Cure formed concrete surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.

D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.

E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
   1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
      a. Water.
      b. Continuous water-fog spray.
      c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch (300-mm) lap over adjacent absorptive covers.
   2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm), and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
      a. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project.
   3. Dissipating Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
      a. After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound will not interfere with bonding of floor covering used on Project.
   4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

F. Slabs Exposed to View: Cure concrete slabs scheduled to remain exposed to view by either moisture curing, moisture-retaining-cover curing, or the application of the curing and sealing compound. Clean the slab surfaces that have been moisture cured or cured using moisture-retaining-covers and uniformly apply a continuous sealing coat of curing and sealing compound to hardened concrete by power spray or roller according to manufacturer's written instructions.

G. Slabs to Receive Floor coverings: Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a dissipating curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project. Remove the curing compound

without damaging the concrete surface unless the floor covering manufacturer certifies curing compound will not interfere with bonding of floor covering used on Project.

3.15 JOINT FILLING

A. Install semirigid joint filler in the warehouse slabs.

B. Prepare, clean, and install joint filler according to manufacturer's written instructions.
   1. Defer joint filling until concrete has aged at least six month(s). Do not fill joints until construction traffic has permanently ceased.

C. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.

D. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches (50 mm) deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

3.16 CONCRETE SURFACE REPAIRS

A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.

B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 (1.18-mm) sieve, using only enough water for handling and placing.

C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
   1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch (13 mm) in any dimension in solid concrete, but not less than 1 inch (25 mm) in depth. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
   2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
   3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.

D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
   1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.08 inch (2 mm) wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.

2. After concrete has cured at least 14 days, correct high areas by grinding.
3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch (6 mm) to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
6. Repair defective areas, except random cracks and single holes 1 inch (25 mm) or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch (19-mm) clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
7. Repair random cracks and single holes 1 inch (25 mm) or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

E. Repair slab surfaces that are not within specified tolerances when tested, by grinding.

F. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.

G. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.17 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Testing laboratory field personnel will immediately notify both the Contractor and the Architect of any concrete, delivered or discharged, which does not meet the Specifications. Concrete which does not conform to all requirements of the Specifications shall not be incorporated in the structure.

C. Inspections:
1. Insulation: Before the vapor barrier is installed, inspect underslab insulation by walking all surfaces and identifying any hollow spots below the insulation for removal and regrading of the top surface of the supporting material.
   a. Reinspect insulation at areas which have been regraded.

2. Steel reinforcement placement. Before concrete is place, inspect reinforcing bars for size, quantity, placement and condition. Notify the Contractor and Architect immediately so that the work can be corrected and reinspected prior to placement of concrete.
   a. Reinspect rebar at areas which have been corrected.
3. Verification of use of required design mixture.
   a. Check truck delivery slips to verify that the mix, as stated on the slip, is correct.
4. Concrete placement, including conveying and depositing.
   a. Note duration of mixing.
5. Curing procedures and maintenance of curing temperature.
6. Verification of concrete strength before removal of shores and forms from beams and slabs.

D. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
   1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd. (4 cu. m), but less than 25 cu. yd. (19 cu. m), plus one set for each additional 50 cu. yd. (38 cu. m) or fraction thereof.
      a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
   2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
   3. Air Content: ASTM C 231, pressure method, for normal-weight concrete; test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
   4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F (4.4 deg C) and below and when 80 deg F (27 deg C) and above, and one test for each composite sample.
   5. Compression Test Specimens: ASTM C 31/C 31M.
      a. Cast and laboratory cure one set of four standard cylinder specimens for each composite sample.
   6. Compressive-Strength Tests: ASTM C 39/C 39M; test one laboratory-cured specimen at 7 days and three specimens at 28 days.
      a. A compressive-strength test shall be the average compressive strength from the three specimens obtained from same composite sample and tested at age indicated.
   7. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi (3.4 MPa).
   8. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
   9. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.

10. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Architect.
11. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
12. Correct deficiencies in the Work that test reports and inspections indicate dos not comply with the Contract Documents at no additional cost to the Owner.

E. Measure floor and slab flatness and levelness within 48 hours of finishing.

END OF SECTION 03 30 00

SECTION 04 20 00
Masonry Work

(Filed Sub-Bid)

1.1 DESCRIPTION

A All of the Contract Documents, including General and Supplementary conditions and Division 0 – Bidding Documents, Contract Forms and Conditions of the Contract and Division 1 – General Requirements, apply to the work in this Section.

B Carefully examine all the Contract Documents for requirements which affect the work of this Section. The exact scope of this Section cannot be determined without a thorough review of all specifications sections and other Contract Documents.

C Where referred to, Standard Specifications, Recommendations of Technical Societies, and/or Manufacturer's Associations, plus Codes of Federal, State, and Local Agencies shall include all amendments current as of date of issue of these specifications.

1.2 REQUIREMENTS FOR SUBMITTING FILED SUB-BID

A. Sub-bids shall be submitted for the Work of this Section in accordance with the provisions of M.G.L. c.149 §§44A-J The time and place for submission of sub-bids are set forth in the **Advertisement.** The procedures and requirements for submitting sub-bids are set forth in the **Instructions to Bidders.**

B. Sub-bidders must be DCAMM Certified in the listed trade and shall include a Current DCAMM sub-bidder Certificate of Eligibility and a signed DCAMM Sub-bidder’s Update Statement with the bid

C. Specification requirements for the Filed Sub-bid "Masonry Work" include all of the following listed Specification Sections in their entirety.

SECTION 04 20 01 - UNIT MASONRY

D. The Work of this Section is shown on Drawings
TS-001, R-101, R-102, A-001, A-002, A-003, A-101, A-104, A-301, A-302, A-401, A-402, A-403, A-404, A-405, A-502, A-503, A-504, A-506, A-507, A-508, A-701, A-801, S-001, S-101

E. SUB-SUBS

1. Sub-sub bids are required for this Section. Sub-Bidders shall include the appropriate information for the list of sub sub-bid Class of Work noted below in this paragraph. NOT APPLICABLE

2. If the Filed Sub-Bidder customarily performs the above Work with its own workforce, the Sub-Bidder should list its own name and trade and leave the dollar amount blank.

3. If the Filed Sub-Bidder does not customarily perform the Classes of Work with its own workforce, the Sub-Bidder should list the name of the contractor performing the work, the trade and insert a dollar amount.

END OF SECTION

SECTION 04 20 01

UNIT MASONRY
(Filed Sub Bid Required as Part of Section 04 20 00)

MORTAR AND GROUT

PART 1 - GENERAL

1.01 SUMMARY

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 1 – GENERAL REQUIREMENTS, which are hereby made a part of this Section of the Specifications.

B. This Sub-Section specified mortar and grout for concrete masonry, clay masonry and calcium silicate masonry unit work.

C. **Work in this Section is included as part of the work in Section 04 20 00**.

1.02 REFERENCES

A. American National Standards Institute (ANSI):
   1. A118.6-10 – Standard Cement Grouts for Tile Installation.

B. ASTM International (ASTM):
   1. C40/C40M-11 – Organic Impurities in Fine Aggregates for Concrete.
   2. C91/C91M-12 – Masonry Cement.
   3. C144-11 – Aggregate for Masonry Mortar.
   4. C150/C150M-15 – Portland Cement.
   5. C207-06(2011) – Hydrated Lime for Masonry Purposes.
   6. C270-14a – Mortar for Unit Masonry.
   7. C404-11 – Aggregates for Masonry Grout.
   8. C476-11 – Grout for Masonry.
   9. C595/C595M-15e1 – Blended Hydraulic Cements.
   10. C780-15 – Preconstruction and Construction Evaluation for Mortars for Plain and Reinforced Unit Masonry.
   11. C979/C979M-10 – Pigments for Integrally Colored Concrete.
   12. C1019-14 – Sampling and Testing Grout.
   13. C1329.C1329M-15 – Mortar Cement.

1.03 SUBMITTALS

A. Submit in accordance with Section 01 33 00, SUBMITTALS.

B. Certificates:
   1. Indicating that the following items meet specification requirements.
      a. Portland cement.
      b. Masonry cement.
      c. Blended hydraulic cement.
      d. Grout.
      e. Hydraulic lime.
      f. Fine aggregate (sand) for mortar and grout.
      g. Coarse aggregate for grout.
      h. Color admixture.

C. Laboratory Test Reports.
   1. Mortar, each type.
   2. Grout, each type.
   3. Admixtures.
   4. Cement.

D. Manufacturer's Literature and Data.
   1. Cement, each type.
   2. Hydrated lime.
   3. Admixtures.
   4. Liquid acrylic resin.

1.04 QUALITY ASSURANCE

A. Preconstruction Testing:
   1. Engage independent testing laboratory to tests and submit reports.
      a. Deliver samples to laboratory in number and quantity required.
   2. Test mortar and materials specified.
   3. Mortar:
      a. Test for compressive strength and water retention according to ASTM C270.
      b. Minimum Mortar compressive strength 28 days:
         1) Type M: 2,500 psi.
         2) Type S: 1,800 psi.
         3) Type N: 750 psi.
   4. Non-Staining Cement: Test for water soluble alkali.
      a. Water Soluble Alkali: Maximum 0.03 percent.
   5. Sand: Test for deleterious substances, organic impurities, soundness and grading.

1.05 DELIVERY, STORAGE AND HANDLING

A. Deliver products in manufacturer's original sealed packaging.

B. Mark packaging, legibly. Indicate manufacturer's name or brand, type, color, production run number, and manufacture date.

C. Before installation, return or dispose or products within distorted, damaged, or opened packaging.

D. Store masonry materials under waterproof covers on planking clear of ground.
   1. Protect loose, bulk materials from contamination.

E. Protect products from damage during handling and construction operations.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Mortar:
   1. Hydrated Lime: ASTM C207, Type S.
   2. Aggregate for Masonry Mortar: ASTM C144 and as follows:
      a. Light colored sand for mortar for laying face brick.
      b. White plastering sand meeting sieve analysis for mortar joints for pointing and laying of structural facing tile units, except that 100 percent passes No. 8 sieve, and maximum 5 percent retained on No. 16 sieve.
      c. Test sand for color value according to ASTM C40/C40M. Sand producing color darker than specified standard is unacceptable.
   3. Blended Hydraulic Cement: ASTM C595/C595M, Type IS, IP.
   4. Masonry Cement: ASTM C91/C91M, Type N, S or M.
      a. Use white masonry cement whenever white mortar is specified.
   5. Mortar Cement: ASTM C1329/C1329M, Type N, S or M.
   6. Portland Cement: ASTM C150.C150M, Type I.
      a. Use white Portland cement whenever white mortar is specified.
   7. Pigments: ASTM C979/C979M; inorganic, inert, mineral pigments only, unaffected by atmospheric conditions, nonfading, alkali resistant, and water soluble.
   8. Water: Potable, free of substances that are detrimental to mortar, masonry and metal.

B. Grout:
   1. Hydrated Lime: ASTM C207, Type S.
   2. Aggregate for Masonry Grout: ASTM C404, Size 8.
   3. Blended Hydraulic Cement: ASTM C595, Type IS, IP.
   4. Portland Cement: ASTM C150, Type I.
   5. Liquid Acrylic Resin: A formulation of acrylic polymers and modifiers in liquid form designed for use as an additive for mortar to improve physical properties.
   6. Water: Potable, free of substances that are detrimental to grout, masonry and metal.

2.02 MIXES

A. Mortar:
1. Pointing Mortar for New Work: Proportion by volume; one part white Portland cement, two parts white sand, and 1/5 part hydrated lime.
2. Masonry Mortar: ASTM C270.
a. Admixtures:
1) Do not use mortar admixtures, and color admixtures unless approved by Architect.
2) Do not use antifreeze compounds.
3. Colored Mortar:
a. Maintain uniform mortar color for exposed work, throughout.
b. Match mortar color in approved sample.
4. Color Admixture: Proportion as specified by manufacturer.

B. Grout:
1. Grout: ASTM C476; fine grout and coarse grout.
2. Color Admixture:
a. Pigments: ASTM C979, inert, stable to atmospheric conditions, nonfading, alkali resistant, and water insoluble.
b. Use mineral pigments only. Organic pigments are not acceptable.
3. Ready-Mixed Grout: ANSI A118.8.

PART 3 - EXECUTION

3.01 PREPARATION

A. Mortar:
1. Examine and verify substrate suitability for product installation.
2. Protect existing construction and completed work from damage.

B. Grout:
1. Examine and verify substrate suitability for product installation.
2. Protect existing construction and completed work from damage.
3. Clean mortar from masonry cells protruding more than ½-inch to permit grout flow.
4. Remove debris from grout spaces.
5. Verify reinforcement is correctly placed before placing grout.

3.02 MIXING

A. Mortar:
1. Measure ingredients by volume using known capacity containers.
2. Mix for 3 to 5 minutes in a mechanically operated mortar mixer.

3. Mix water with dry ingredients in sufficient amount to provide a workable mixture which will adhere to vertical surfaces or masonry units.
4. Mortar Stiffened Because of Water Loss Through Evaporation:
   a. Re-temper by adding water to restore proper consistency and workability.
   b. Discard mortar reaching initial set or unused within two hours of mixing.
5. Pointing Mortar:
   a. Mix dry ingredients with enough water to produce damp mixture of workable consistency retaining shape when formed into ball.
   b. Allow mortar to stand in dampened condition for 60 to 90 minutes.
   c. Add water to bring mortar to a workable consistency before use.

B. Grout:
1. Mix grout in mechanically operated mixer.
   a. Mix grout for five minutes, minimum.
2. Measure ingredients by volume using container of know capacity.
3. Mix water with grout dry ingredients.
   a. Slump range: 8 to 11 inches.

3.03 MORTARING

A. Type M Mortar: For reinforced unit masonry work, masonry below grade and for waterproofing parging for concrete masonry unit basement walls.

B. Type S Mortar: For veneer masonry and setting cast stone.

C. Type N Mortar: For all other masonry work, except as otherwise specified.

3.04 GROUTING

A. Use fine grout for filling wall cavities and hollow concrete masonry units where smallest cell dimensions is 2 inches or less.
B. Use either fine or coarse grout for filling wall cavities and hollow concrete masonry units where smallest cell dimensions is greater that 2 inches.
C. Use grout or filling bond beams or lintel units.

END OF MORTAR AND GROUT

UNIT MASONRY

PART 1 - GENERAL

1.01 SUMMARY

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 1 – GENERAL REQUIREMENTS, which are hereby made a part of this Section of the Specifications.

B. This Sub-Section specifies unit masonry work.

C. **Work in this Section is included as part of the work in Section 04 20 00**.

1.02 RELATED SECTIONS

A. Section 03 30 00, CAST IN PLACE CONCRETE.

B. Section 05 50 00, METAL FABRICATIONS.

C. Section 05 51 00, METAL STAIRS.

D. Section 06 10 00, ROUGH CARPENTRY.

E. Section 07 27 26, AIR BARRIER.

F. Section 07 42 00, METAL WALL PANELS.

G. Section 07 60 00, FLASHING AND SHEET METAL.

H. Section 07 84 00, FIRESTOPPING.

I. Section 07 90 00, SEALANTS AND CAULKING.

J. Section 08 33 23, ROLLING DOORS.

K. Section 09 90 10, PAINTING.

L. Section 13 34 19, PRE-ENGINEERED BUILDING.

1.03 REFERENCES

A. American Concrete Institute (ACI):
   1. 315-99 – Details and Detailing for Concrete Structures.

2. 530.1/ASCE 6/TMS 602-13 – Specification for Masonry Structures.

B. ASTM International (ASTM):
1. A153/A513M – Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
2. A580/A580M – Standard Specification for Stainless Steel Wire.
3. A615/A615M-15ae1 – Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
4. A666 – Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar
5. A951/A951M-14 – Steel Wire for Masonry Joint Reinforcement.
6. A1064/A1064M-15 – Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
7. C34-13 – Structural Clay Load-Bearing Wall Tile.
8. C55-14a – Concrete Building Brick.
9. C56-13 – Structural Clay Nonloadbearing Tile.
10. C62-13a – Building Brick (Solid Masonry Units Made from Clay or Shale).
11. C67-14 – Sampling and Testing Brick and Structural Clay Tile.
12. C90-14 – Load-Bearing Concrete Masonry Units.
13. C126-15 – Ceramic Glazed Structural Clay Facing Tile, Facing Brick, and Solid Masonry Units.
14. C216-15 – Facing Brick (Solid Masonry Units Made From Clay or Shale).
15. C612-14 – Mineral Fiber Block and Board Thermal Insulation.
16. C744-14 – Prefaced Concrete and Calcium Silicate Masonry Units.
17. D146 – Standard Test Methods for Sampling and Testing Bitumen-Saturated Felts and Woven Fabrics for Roofing and Waterproofing.
18. D412 – Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers – Tension.
19. D570 – Standard Test Method for Water Absorption of Plastics.
20. D781 – Method of Test for Puncture and Stiffness of Paperboard, Corrugated and Solid Fiberboard.
21. D882 – Standard Test Method for Tensile Properties of Thin Plastic Sheeting.
22. D903 – Standard Test Method for Peel or Stripping Strength of Adhesive Bonds.
23. D1004 – Standard Test Method for Tear Resistance (Graves Test) of Plastic Film and Sheeting.
24. D1056-14 – Flexible Cellular Materials – Sponge or Expanded Rubber.
25. D1938 – Standard Test Method for Tear-Propagation Resistance (Triuser Tear) of Plastic Film and Thin Sheeting by a Single-Tear Method.
26. D2240-05 (2010) – Rubber Property-Durometer Hardness.
27. D2287 – Standard Specification for Nonrigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds.
28. F1667-15 – Driven Fasteners: Nails, Spikes, and Staples.

C. American Welding Society (AWS):
1. D1.4/D1.4M-11 – Structural Welding Code – Reinforcing Steel.

D. Brick Industry Association (BIA):
   1. TN 11B-88 – Guide Specification for Brick Masonry, Part 3.

E. Federal Specifications (Fed. Spec.):
   1. FF-S-107C(2) – Screws, Tapping and Drive.

F. TMS402/ACI1530/ASCE6 – Specifications for Masonry Structure; 2013.

G. Masonry Standards Joint Committee (MSJC):
   1. Building Code Requirements for Masonry Structures.
   2. Specifications for Masonry Structures.

1.04 SUBMITTALS

A. Submit in accordance with Section 01 33 00, SUBMITTALS.

B. Submittal Drawings:
   1. Fabrication, bending, and placement of reinforcing bars. Comply with ACI 135. Show bar schedules, diagrams of bent bars, stirrup spacing, lateral ties, and other arrangements and assemblies.
   2. Special masonry shapes, profiles, and placement.
   3. Masonry units for typical window and door openings, and, for special conditions as affected by structural conditions.

C. Manufacturer's Literature and Data:
   1. Description of each product.
   2. Installations instructions.

D. Samples:
   1. Split Face CMU: Sample panel, 8 inches by 16 inches, showing full color range and texture of bricks, bond, and proposed mortar joints.
   2. Concrete masonry units, when exposed in finish work.
   3. Anchors and Ties: Each type.
   4. Joint Reinforcing: 48 inches long each type.

E. Test Reports: Certify products comply with specifications.

F. Certificates: Certify products comply with specifications.
   1. Split Face CMU.
   2. Solid and load-bearing concrete masonry units, including fire-resistant rated units.

1.05 QUALITY ASSURANCE

A. Welders and Welding Procedures Qualifications: AWS D1.4/D1.4M.

B. Mockups:
   1. Before starting masonry, build a mockup panel minimum 6 feet by 6 feet with 24 inch 90 degree returns for outside corner.
      a. Use masonry units from random cubes of units delivered on site.
      b. Include structural backup, reinforcing, ties, and anchors.
   2. Mockup panel approved by Architect set workmanship and aesthetic quality for masonry work.
   3. Clean sample panel to test cleaning methods.
   4. Remove mockup panel when directed by Architect.

1.06 DELIVERY, STORAGE AND HANDLING

A. Deliver products in manufacturer's original sealed packaging.

B. Mark packaging, legibly. Indicate manufacturer's name or brand, type, color, production run number, and manufacture date.

C. Before installation, return or dispose of products within distorted, damaged, or opened packaging.

D. Store products above grade, protected from contamination.

E. Protect products from damage during handling and construction operations.

1.07 GUARANTEE

A. Guarantee exterior masonry walls against moisture leaks and subject to terms of the GENERAL CONDITIONS, except that guaranty period shall be five years.

PART 2 - PRODUCTS

2.01 PRODUCTS

A. Provide each type of product from one manufacturer and from one production run.

2.02 UNIT MASONRY PRODUCTS

A. Split Face Concrete Masonry Units:
   1. Product: A. Jandris & Sons standard split face, or approved equal.
      a. Normal weight, integrally pigmented loadbearing hollow units.
      b. ASTM C90.

c. Coloring: Integral, through-body coloring; synthetic or natural iron oxide pigments.
d. Size: 3-5/8" wide x 7-5/8" high x 15-5/8" long.
   1) Modular.
e. Color: LT-20.

B. Concrete Masonry Units (CMU):
1. Hollow and Solid Load-Bearing Concrete Masonry Units: ASTM C90.
   a. Unit Weight: Normal weight.
   b. Fire rated units for fire rated partitions.
2. Sizes: Modular, 8 inches by 16 inches nominal face dimension; thickness as indicated on Drawings.
3. For molded faces used as a finished surface, use concrete masonry units with uniform fine to medium surface textures unless specified otherwise.
4. Use bullnose concrete masonry units at corners exposed in finished work with 1 inch minimum radius rounded vertical exterior corners.

C. Concrete Brick: ASTM C55.

2.03 ANCHORS, TIES AND REINFORCEMENT

A. Steel Reinforcing Bars: ASTM A615/A615M; Grade 60, deformed bars.

B. Joint Reinforcement:
1. Form from wire complying with ASTM A951/A951M.
2. Hot dipped galvanized after fabrication.
3. Width of joint reinforcement 1.6 inches less than nominal thickness of masonry wall or partition.
4. Cross wires welded to longitudinal wires.
5. Joint reinforcement minimum 10 feet long, factory cut.
6. Joint reinforcement with crimp formed drip is not acceptable.
7. Maximum spacing of cross wires 16 inch to longitudinal wires.
8. Ladder Design:
   a. Longitudinal wires deformed 0.16 inch diameter wires.
   b. Cross wires 0.16 inch diameter.
9. Trussed Design:
   a. Longitudinal and cross wires minimum 0.16 inch nominal diameter.
   b. Longitudinal wires deformed.

C. Masonry Veneer Wall Ties (Concrete or Masonry Backup):
1. Manufacturer: Hohmann & Barnard, Inc. Thermal Concrete 2-Seal™ Wing Nut Anchor, or approved equal.
2. Dual-diameter barrel with factory-installed EPDM washers to seal both the face of the insulation and air barrier.

3. Barrel: Stainless steel ASTM A580/A580M, AISI Type 304. Length of barrel to match insulation depth, see Drawings.
4. Screw: Carbon steel ASTM A510.
5. Masonry Veneer Ties: Provide minimum 2 inches embedment in mortar.
   a. Hook: Hot-dip galvanized 3/16 inch diameter x length required for embedment, ASTM A153/A153M.
   b. Continuous Wire: Hot-dip galvanized 3/16 inch diameter, ASTM A153/A153M.
   c. Seismic Clip: Extrusion of durable, impact-resistant, rigid polyvinyl chloride.
      1) Cell Classification: ASTM D1781.
      2) Hardness Shor D: ASTM S2240.
      3) Tensile Yield & Modulus: ASTM D638.
      4) Flexural Strength & Modulus: ASTM D790.

2.04 ACCESSORIES

A. Open Weave Weeps:
   1. Recycled polyester/polyurethane bonded with a flame retardant adhesive to provide resiliency and strength, plus an anti-microbila additive to control mold growth. Normal size 2 5/8" high by 3 ½" wide by ½" thick.
   2. Install one per weep as noted on Drawings and minimum 16" o.c.
   3. Manufacturer: Mortar Net USA, Ltd., or approved equal.

B. Cavity Drain Material:
   1. Recycled polyester/polyurethane mesh trapezoidal-shape to maintain cavity airflow and drainage while suspending mortar droppings at unequal heights.
   2. Install one or more thickness as required to fill cavity width.
   3. Manufacturer: Mortar Net USA, Ltd., or approved equal.

C. Membrane Wall Flashing:
   1. General: Composite membrane consisting of 32 mils of self-adhering SBS rubberized asphalt laminated to an 8 mil cross-laminated, high density, polyethylene film with siliconized release liner.
   2. Thickness: 40 mil.
   3. Width: Minimum 18 inches.
   4. Solids: 100%.
   5. Weight: 0.30 lb/ft².
   6. Storage Temperature: 40 to 100 °F.
   7. Application Temperature: Above 40 °F and rising.
   8. Technical Data:

Property	Average Values	Test Method
Maximum V.O.C.	0 g/L	Method 310
Elongation	250%	ASTM D412 Die C
Tensile Strength	500 psi	ASTM D412 Die C
Moisture Absorption	0.1%	ASTM D570

Water Vapor Permeance	0.02 US Perms	ASTM E96 Dry Cup
Tensile Strength	5.994 N/mm	ASTM D882
Pliability, 180°, 1" mandrel @ -29 °F (Low Temperature Flex)	Pass	ASTM D1970 Section7.6
Puncture Resistance	70 lbf	ASTM E154
Nail Sealability	Pass	ASTM D1970 Section 7.9
Evaluation of Fire Propagation Characteristics	Evaluated	NFPA 285

9. Manufacturer: Tremco Exoair® TWF, or approved equal.

D. Cavity Drainage Mat:
   1. 45-mil EPDM flashing membrane.
   2. Mortar Collection Drainage Mat and Drainage Weep Tabs: Recycled polyester impregnated with biocide to resist mold growth and flame retardant. High loft, non-woven mesh designed to allow moisture to migrate to the integrated weep tabs; product adhered to the flashing membrane.
      a. Thickness: ¼ inch.
      b. Height: 10 inches.
      c. Length: 5 feet.
   3. Standard Size: 18 inches x 5-1/2 feet.
   4. Manufacturer: Mortar Net USA, Ltd. TotalFlash® Roll, or approved equal

E. Termination Bar:
   1. Material: Stainless steel, ASTM 580/580M Type 304.
   2. Dimensions: 1/8" by 1" wide by 10'-0" sections with 3/8" slotted holes at 8" o.c.
   3. Manufacturer: Hohmann & Barnard, Inc., T1 Termination Bar, or approved equal.

F. Drip Plate:
   1. Material: Stainless steel, ASTM 580/580M Type 304.
   2. Dimension: 26 gauge, 3" wide with 3/8" closed hem drip edge.
   3. Manufacturer: Hohmann & Barnard, Inc., Drip Plate, or approved equal.

G. Partition Top Anchors:
   1. 12 ga. stainless steel conforming to ASTM A666, Type 304. Block size 8", bend length minimum 2" down from top of CMU, to be coordinated by Contractor.
   2. Manufacturer: Hohmann & Barnard, Inc., PTA 422, or approved equal.

H. PVC Control Joint:
   1. Extruded from PVC compound with 85 durometer hardness conforming to ASTM D2287 Type 654, ASTM D2240. Depth to match CMU thickness, flange thickness ¼".
   2. Manufacturer: Hohmann & Barnard, Inc., VS Series, or approved equal.

I. Premolded Joint Filler:
   1. Premolded joint filler shall be 3/8" thick closed cell neoprene. Rapid Expansion Joint D/A 2015 by Dur-O-Wall Inc., or approved equal.

J. Box Board:
   1. Mineral Fiber Board: ASTM C612, Type 1.
   2. 1 inch thickness.
   3. Other spacing material having similar characteristics is acceptable subject to Architect's approval.

K. Masonry Reglet:
   1. Impact-resistant, rigid polyvinyl chloride.
      a. Cell Classification – ASTM D1781.
      b. Hardness Shore D – ASTM D2240.
      c. Tensile Yield & Modulus – ASTM D638.
      d. Flexural Strength & Modulus – ASTM D790.
   2. 8 ft. long. 5/8" internal depth, 1-1/4" o.a. depth.
   3. Manufacturer: Hohmann & Barnard, Inc., MR Masonry Reglet, or approved equal.

L. Masonry Cleaner:
   1. Detergent type cleaner selected for each type of masonry.
   2. Acid cleaners are not acceptable.
   3. Use soapless type specially prepared for cleaning brick or concrete masonry as appropriate.

M. Fasteners:
   1. Concrete Nails: ASTM F1667, Type I, Style 11, ¾ inch minimum length.
   2. Masonry Nails: ASTM F1667, Type I, Style 17, ¾ inch minimum length.
   3. Screws: FS-FF-S-107, Type A, AB, SF thread forming or cutting.

N. Welding Materials: AWS D1.4/D1.4M, type to suit application.

PART 3 - EXECUTION

3.01 POLLUTION CONTROL

A. Contractor shall be aware that the buildings must remain in operation throughout the course of construction and that any disruption or inconvenience sustained by the Owner or nearby residents must be kept to an absolute minimum. To this end, the Contractor shall provide, if necessary, a water spray and an impermeable barrier and any other equipment or procedures necessary to minimize dust and debris infiltration. Also, the Contractor shall select equipment and procedures to mitigate noise discomfort.

B. All masonry rubble shall be considered the property of the masonry contractor and shall be deposited into containers on the site in its entirety on a daily basis and be legally dispose. On site storage of discarded material will be permitted in a covered container which is to be locked at the end of each workday.

C. Contractor shall supply a chute for removal from the roof if necessary to limit the spread of dust or debris.

3.02 JOB CONDITIONS

A. Protection:
   1. Cover tops of walls with non-staining waterproof covering, when work is not in progress. Secure to prevent wind blow off.

B. Cold Weather Protection:
   1. Masonry may be laid in freezing weather when methods of protection are utilized.
   2. Comply with cold weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

C. Sub-contractor is responsible for hoisting and rigging of materials and equipment for all work associated with this section.

3.03 INSTALLAION – GENERAL

A. Install products according to manufacturer's instructions and approved submittal drawings.
   1. When manufacturer's instructions deviate from specifications, submit proposed resolution for Architect's consideration.

B. Keep finish work free from mortar smears or spatters, and leave neat and clean.

C. Wall Openings:
   1. Fill hollow metal frames built into masonry walls and partitions solid with mortar as laying of masonry progresses.
   2. When items are not available when walls are built, prepare openings for subsequent installation.

D. Tooling Joints:
   1. Do not tool until mortar has stiffened enough to retain thumb print when thumb is pressed against mortar.
   2. Tool while mortar is soft enough to be compressed into joints and not raked out.
   3. Finish joints in exterior face masonry work with jointing tool, and provide smooth, water-tight concave joint unless specified otherwise.
   4. Tool exposed interior joints in finish work concave unless specified otherwise.

E. Partition Heights:
   1. Extend partitions minimum 4 inches above ceiling or to overhead construction where no ceiling occurs. Refer to Drawings for specific partition and wall heights.
   2. Extend the following partitions to overhead construction.
      a. Full height partitions, and fire partitions and smoke partitions indicated on Drawings.
      b. Both walls at expansion joints.
      c. Corridor walls, unless otherwise noted.
      d. Walls at stairway and stair halls, elevators and other vertical shafts.

F. Lintels:
   1. Lintels are not required for openings less than 40 inches wide that have hollow metal frames.
   2. Openings 40 inches wide to 63 inches wide without structural steel lintel or frames, require lintel formed of concrete masonry lintel, filled with grout and reinforced with one No. 5 top and bottom for each 4 inches of nominal thickness unless shown otherwise.
   3. Precast concrete lintels of 3,000 psi concrete, same thickness as partition, and with one No. 5 deformed bar top and bottom for each 4 inches of nominal thickness, is acceptable in lieu of reinforced CMU masonry lintels.
   4. Use steel lintels, for openings greater than 64 inches wide, brick masonry openings, and elevator openings unless otherwise shown.
   5. Doors having overhead concealed door closers require steel lintel, and pocket for door closer.
   6. Lintel Bearing Length: Minimum 8 inches at both ends.
   7. Build masonry openings or arches over wood or metal centering and supports when steel lintels are not used.

G. Wall, Furring and Partition Units:
   1. Lay out field units to provide one-half running bond, unless otherwise indicated.
   2. Align head joints of alternate vertical courses.
   3. At sides of openings, balance head joints in each course on vertical center lines of openings.
   4. Minimum Masonry Unit Length: 4 inches.
   5. On interior partitions provide ¼ inch open joint for caulking between existing construction, exterior walls, concrete work and abutting masonry partitions.
   6. Use minimum 4 inches nominal thick masonry for free standing furring, unless indicated otherwise.
   7. Do not abut existing plastered surfaces except suspended ceilings with new masonry partitions.

H. Use minimum 4 inches nominal thick masonry for fireproofing steel columns unless indicated otherwise.

I. Before connecting new masonry with previously laid masonry, remove loosened masonry or mortar, and clean and wet work in place as specified under wetting.

J. When new masonry partitions start on existing floors, machine cut existing floor finish material down to concrete surface.

K. Structural Steel Encased in Masonry:
   1. Where structural steel is encased in masonry and voids between steel and masonry are filled with mortar, provide minimum 1 inch mortar free expansion space between masonry and steel by applying box board material to steel before masonry is laid.
   2. Do not install spacing material where steel is bearing on masonry or masonry is bearing on steel.

L. Chases:
   1. Do not install chases in masonry walls and partitions exposed to view in finished work, including painted or coated finishes on masonry.
   2. Masonry 4 inch nominal thick may have electrical conduits 1 inch or less in diameter when covered with soaps, or other finishes.
   3. Fill recess chases after installation of conduit, with mortar and finish flush.
   4. When pipes or conduits, or both occur in hollow masonry unit partitions retain minimum one web of hollow masonry units.

M. Wetting and Wetting Test:
   1. Test and wet brick and clay tile according to BIA TN 11B.
   2. Do not wet concrete masonry units before laying.

N. Bond Pattern:
   1. Install accessories in accordance with manufacturer's recommendations.

3.04 INSTALLATION – ANCHORAGE

A. Masonry Facing to Backup and Cavity Wall Ties:
   1. Use individual ties for new work.
   2. Stagger ties in alternate courses and space at 16 inches maximum vertically and 16 inches horizontally.
   3. Install continuous wire 1 inch back from face of masonry and seismic clip at each tie.
   4. At openings, provide additional ties spaced not more than 3 feet apart vertically around perimeter of opening, and within 12 inches from edge of openings.
   5. Fasten ties to metal or steel studs, concrete and masonry in accordance with manufacturer's recommendations.

3.05 INSTALLATION – REINFORCEMENT

A. Joint Reinforcement:
   1. Install joint reinforcement in CMU wythe of combination brick and CMU, cavity walls, and single wythe concrete masonry unit walls or partitions.
   2. Locate joint reinforcement in mortar joints at 16 inch maximum vertical intervals.
   3. Additional joint reinforcement is required in mortar joints at both 8 inches and 16 inches above and below windows, doors, louvers and similar openings in masonry.
   4. Wherever brick masonry is backed up with stacked bond masonry, install multiple wythe joint reinforcement in every two courses of CMU backup, and in corresponding joint of facing brick.

B. Steel Reinforcing Bars:
   1. Install reinforcing bars in cells of hollow masonry units where required for vertical reinforcement and in bond beam units for horizontal reinforcement. Install in wall cavities of reinforced masonry walls where indicated on Drawings.
   2. Bond Beams:
      a. Form bond beams of load-bearing concrete masonry units filled with grout and reinforced with two No. 5 reinforcing bars unless shown otherwise. Do not cut reinforcement.
      b. Break bond beams only at expansion joints and at control joints, if shown.
   3. Stack Bond:
      a. Locate additional joint reinforcement in vertical and horizontal joints as indicated on Drawings.
      b. Anchor vertical reinforcement into foundation or wall or bond beam below.
      c. Provide temporary bracing for walls over 8 feet tall unit permanent horizontal bracing is completed.
   4. Grout Openings:
      a. Leave cleanout holes in double wythe walls during construction by omitting units at base of one side of the walls.
      b. Locate 3 inches by 3 inches minimum cleanout holes at location of vertical reinforcement.
      c. Keep grout space clean of mortar accumulation and debris. Clean as work progresses and immediately before grouting.

3.06 INSTALLATION – EXPANSION AND CONTROL JOINTS

A. Provide expansion joint (EJ) and control joint (CJ) where indicated on Drawings.

B. Keep joint free of mortar and other debris.

C. Joint Occur in Masonry Walls:
   1. Install preformed compressible joint filler in brick wythe.

2. Install cross shaped shear keys in concrete masonry unit wythe with preformed compressible joint filler on both sides of shear key.

D. Use standard notched concrete masonry units (sash blocks) made in full and half-length units where shear keys are used to create a continuous vertical joint.

E. Interrupt joint reinforcement at expansion and control joints.

F. Fill opening in exposed face of expansion and control joints with sealant as specified in Section 07 90 00, SEALANTS AND CAULKING.

3.07 INSTALLATION – SPLIT FACE CMU

A. Split Face Concrete Masonry Veneer Unit:
1. Install concrete masonry veneer units in accordance with MSJC Specifications for Masonry Structures and manufacturer's instructions.
2. Bond Pattern for Exposed Masonry: Running bond.
3. Lay units by selecting product from more than one pallet at a time during installation.
4. Lay units with full mortar head and bed joints.
5. All cutting shall be done with masonry saw to provide clean, sharp, unchipped edges.
6. Do not use masonry units with broken corners and edges in excess of ASTM C90 and ASTM C1634.

B. Weeps:
1. Install weeps at 16 inches on center in bottom of vertical joints of exterior masonry veneer or cavity wall facing over foundations, bond beams, and other water stops in wall.
2. Form weeps by leaving vertical joint free of mortar (one course).

C. Cavity Walls:
1. Keep air space of mortar accumulations and debris.
2. Lay the interior wythe of the masonry wall full height where damproofing or air barrier is required on the cavity face. Coordinate to install damproofing or air barrier before laying outer wythe.
3. Veneer Framed Walls:
   a. Build with 4 inches of split face cmu over sheathed stud wall with air space.

3.08 INSTALLATION – CONCRETE MASONRY UNITS

A. Types and Uses:

1. Provide special concrete masonry shapes as required, including lintel and bond beam units, sash units, and corner units. Provide solid concrete masonry units, where full units cannot be installed, or where needed for anchorage of accessories.
2. Provide solid load-bearing concrete masonry units or grout cell of hollow units at jamb of openings in walls, where structural members impose loads directly on concrete masonry, and where shown.
3. Provide rounded corner (bullnose) shapes at opening jambs in exposed work and at exterior corners.
4. Do not install brick jambs in exposed finish work.
5. Install concrete building brick only as filler in backup material where not exposed.
6. Construct fire resistance in fire rated partitions meeting fire ratings indicated on Drawings.

B. Laying:
1. Lay concrete masonry units with 3/8 inch joints, with a bond overlap of minimum ¼ of unit length, except where stack bond is indicated on Drawings.
2. Do not wet concrete masonry units before laying.
3. Bond external corners of partitions by overlapping alternate courses.
4. Lay first course in a full mortar bed.
5. Set anchorage items as work progress.
6. Where ends of anchors, bolts, and other embedded items, project into voids of units, completely fill voids with mortar or grout.
7. Provide ¼ inch open joint for sealant between existing construction, exterior walls, concrete work, and abutting masonry partitions.
8. Lay concrete masonry units with full face shell mortar beds and fill head joint beds for depth equivalent to face shell thickness.
9. Lay concrete masonry units so cores of units, that are to be filled with grout, are vertically continuous with joints of cross webs of such cores completely filled with mortar. Unobstructed core openings minimum 2 inches by 3 inches.
10. Do not wedge masonry against steel reinforcing. Minimum ½ inch clear distance between reinforcing bars of sizes indicated on Drawings.
11. Install deformed reinforcing bars of sizes indicated on Drawings.
12. At time of placement, ensure steel reinforcement is free of loose rust, mud, oil, and other contamination capable of affecting bond.
13. Place steel reinforcement at spacing indicated on Drawings before grouting.
14. Minimum clear distance between parallel bars: One bar diameter.
15. Hold vertical steel reinforcement in place vertically by centering clips, caging devices, tie wires, or other approved methods.
16. Support vertical bars near each end and at maximum 192 bar diameter on center.
17. Splice reinforcement or attach reinforcement to dowels by placing in contact and securing with wire ties.
18. Stagger splices in adjacent horizontal reinforcing bars. Lap reinforcing bars at splices a minimum of 40 bar diameters.
19. Grout cells of concrete masonry units, containing reinforcing bars, solid as specified.

20. Install cavity and joint reinforcement as masonry work progresses.
21. Rake joints ¼ to 3/8 inch deep for pointing with colored mortar when colored mortar is not full depth.

3.09 POINTING

A. Fill joints with pointing mortar using rubber float trowel to apply mortar solidly into raked joints.

B. Tool exposed joints to smooth concave joint.

C. At joints with existing work, match existing joint.

3.10 GROUTING

A. Preparation:
   1. Clean grout space of mortar droppings before placing grout.
   2. Close cleanouts.
   3. Install vertical solid masonry dams across grout space for full height of wall at intervals of maximum 30 feet. Do not bond dam units into wythes as masonry headers.
   4. Verify reinforcing bars are installed as indicated on Drawings.

B. Placing:
   1. Place grout in grout space in lifts as specified.
   2. Consolidate each grout lift after free water has disappeared but before plasticity is lost.
   3. Do not slush with mortar or use mortar with grout.
   4. Interruptions:
      a. When grouting must be stopped for more than an hour, top off grout 1-1/2 inches below top of last masonry course.
      b. Grout from dam to dam on high lift method.
      c. Longitudinal run of masonry may be stopped off only by raking back one-half masonry unit length in each course and stopping grout 4 inches back of rake on low lift method.

C. Puddling Method:
   1. Consolidate by puddling with grout stick during and immediately after placing.
   2. Grout cores of concrete masonry units containing reinforcing bars solid as masonry work progresses.

D. Low Lift Method:
   1. Construct masonry to 5 feet maximum height before grouting.

2. Grout in one continuous operation and consolidate grout by mechanical vibration and reconsolidate after initial water loss and settlement has occurred.

E. High Lift Method:
   1. Do not pour grout until masonry wall has cured minimum of 4 hours.
   2. Place grout in 5 feet maximum lifts.
   3. Exception:
      a. Where following conditions are met, place grout in 12.67 maximum lifts.
      b. Masonry has cured minimum 4 hours.
      c. Grout slump is maintained between 10 and 11 inches.
      d. No intermediate reinforced bond beams are placed between top and bottom of grout lift.
   4. When vibrating succeeding lifts, extend vibrator 12 to 18 inches into preceding lifts.

3.11 PLACING REINFORCEMENT

A. General: Clean reinforcement of loose rust, mill scale, earth, ice or other materials which will reduce bond to mortar or grout. Do not use reinforcement bars with kinks or bends not shown on the drawings or approved submittal drawings, or bars with reduced cross-section due to excessive rusting or other causes.

B. Position reinforcement accurately at spacing indicated on Drawings. Support and secure vertical bars against displacement. Install horizontal reinforcement as masonry work progresses. Where vertical bars are shown in close proximity, provide clear distance between bars of minimum one bar distance or 1 inch, whichever is greater.

C. For columns, piers and pilasters, maintain clear distance between vertical bars as indicated on Drawings, minimum 1.5 bar diameters or 1-1/2 inches, whichever is greater. Provide lateral ties as indicated on Drawings.

D. Splice reinforcement bars only where indicated on Drawings, unless approved by Architect. Provide lapped splices. In splicing vertical bars or attaching to dowels, lap ends, place in contact and wire tie.

E. Provide minimum lap as indicated on approved submittal drawings, or if not indicated, minimum 48 bar diameters.

F. Weld splices where indicated on Drawings according to AWS D1.4/D1.4M.

G. Embed metal ties in mortar joint as work progresses, with minimum mortar cover of 5/8 inch on exterior face walls and ½ inch at other locations.

H. Embed prefabricated horizontal joint reinforcement as work progresses, with minimum cover of 5/8 inch on exterior face of walls and ½ inch at other locations. Lap joint reinforcement minimum 6 inches at ends. Use prefabricated "L" and "T" sections to provide continuity at corners and intersections. Cut and bend joint reinforcement for continuity at returns, offsets, column fireproofing, pipe enclosures and other special conditions.

I. Anchoring: Anchor reinforced masonry work to supporting structure as indicated on Drawings.

J. Anchor reinforced masonry walls at intersections with non-reinforced masonry.

3.12 CONSTRUCTION TOLERANCES

A. Lay masonry units plumb, level and true to line within tolerances according to ACI 530.1/ASCE 6/TMS 602 and as follows:

B. Maximum variation from plumb:
   1. In 10 feet – ¼ inch.
   2. In 20 feet – 3/8 inch.
   3. In 40 feet or more – ½ inch.

C. Maximum variation from level:
   1. In any bay or up to 20 feet – ¼ inch.
   2. In 40 feet or more – ½ inch.

D. Maximum variation from linear building lines:
   1. In any bay or up to 20 feet – ½ inch.
   2. In 40 feet or more – ¾ inch.

E. Maximum variation in cross-sectional dimensions of columns and thickness of walls from dimension shown:
   1. Minus ¼ inch.
   2. Plus ½ inch.

F. Maximum variation in prepared opening dimensions:
   1. Accurate to minus 0 inch.
   2. Plus ¼ inch.

3.13 CLEANING AND REPAIR

A. Damage to any portion of the building which results in disruption of, or inconvenience to, the Owner or other residents shall be immediately repaired or

replaced by the Contractor. If such restitution is not promptly made, the Owner shall have the necessary work performed by an outside agency at the Contractor's expense.

B. Exterior exposed facing and existing and new masonry surfaces shall be cleaned of all mortar droppings, stains and foreign substances with masonry cleaner. Marred, cracked, scratched or chipped surfaces will not be accepted.

C. Water run off during saw-cutting and masonry shall not be permitted to stain existing building, sidewalks, curbs, and roof areas.

D. Protect all surrounding roof areas from contact with any cleaning solutions as approved by the Architect.

E. Non-masonry building component surfaces shall be protected from contact with any cleaning solution. Wood, metal and painted surfaces (including glass and translucent panel surfaces) shall be protected with sheets of polyethylene, or other proven protective materials, firmly fixed and sealed to the surface. Non-masonry surfaces that are not protected shall be kept running-wet with clean water throughout the cleaning process of adjacent masonry.

F. For cleaning exterior brickwork, provide adequate ventilation, extend every effort to avoid multiple rinsing, protect adjacent non-masonry surfaces. Neutralizing acidic preparations may be employed to avoid excessive rinse waters subject to Architect's approval. Construct dams to contain effluent and dispose of same legally.

G. All open joints shall be temporarily caulked or otherwise protected to prevent intrusion of washing waters onto the wall structure or building interior.

H. Cleaning operations shall be conducted at a time of year when masonry and concrete surfaces will have adequate time to thoroughly dry without fear of freezing.

I. Any dilution of cleaning materials shall be with clean water according to the instructions on the manufacturer's printed label (container label).

J. All surfaces shall be thoroughly pre-wet with clean water prior to the application of all cleaning materials. The purpose of pre-wetting is to limit the activity of the cleaning solutions to the masonry surface and prevent the cleaning solutions from being too readily absorbed by the dry masonry. Failure to adequately pre-wet may result in streaking and other residual staining of the treated masonry. When working from staging, keep lower areas wet at all times to avoid streaking.

K. High pressure rinsing equipment may prove beneficial for the pre-wetting and rinsing procedures described below. Pressure of 400-800 PSI and a flow rate of four to six gallons per minute have proved most effective.

L. Pressure application of cleaning materials is not permitted.

M. Detergent cleaner may be employed for removal of excess mortars and job dirt in the following manner unless otherwise indicated by testing.
   1. Scrape off excess mortar deposits with sections of brick, wooden scrapers or other non-metallic scraping devices.
   2. Thoroughly pre-wet a large area of the masonry surface to be cleaned.
   3. Using a densely packed, soft fibered masonry washing brush or low pressure spray, apply the prepared (diluted) cleaning solution freely.
   4. Allow the cleaning solution to stay on the wall for one to three minutes depending upon drying conditions. (Do not allow the cleaning solution to dry in.).
   5. Scrape off excess mortar deposits and reapply the opening solution in a scrubbing manner.
   6. Rinse treated surfaces thoroughly with fresh water employing available water pressure or pressure washing equipment, removing all cleaning compounds, dirt, etc.
   7. Reapply as necessary.

END OF SECTION

SECTION 05 01 00
Miscellaneous Metals

(Filed Sub-Bid)

1.1 DESCRIPTION

A All of the Contract Documents, including General and Supplementary conditions and Division 0 – Bidding Documents, Contract Forms and Conditions of the Contract and Division 1 – General Requirements, apply to the work in this Section.

B Carefully examine all the Contract Documents for requirements which affect the work of this Section. The exact scope of this Section cannot be determined without a thorough review of all specifications sections and other Contract Documents.

C Where referred to, Standard Specifications, Recommendations of Technical Societies, and/or Manufacturer's Associations, plus Codes of Federal, State, and Local Agencies shall include all amendments current as of date of issue of these specifications.

1.2 REQUIREMENTS FOR SUBMITTING FILED SUB-BID

A. Sub-bids shall be submitted for the Work of this Section in accordance with the provisions of M.G.L. c.149 §§44A-J The time and place for submission of sub-bids are set forth in the **Advertisement.** The procedures and requirements for submitting sub-bids are set forth in the **Instructions to Bidders.**

B. Sub-bidders must be DCAMM Certified in the listed trade and shall include a Current DCAMM sub-bidder Certificate of Eligibility and a signed DCAMM Sub-bidder’s Update Statement with the bid

C. Specification requirements for the Filed Sub-bid "Miscellaneous Metals" include all of the following listed Specification Sections in their entirety.

SECTION 05 50 00 - METAL FABRICATIONS
SECTION 05 51 00 - METAL STAIRS

D. The Work of this Section is shown on Drawings
TS-001, R-101, R-102, A-001, A-101, A-102, A-104, A-301, A-302, A-401, A-503, A-504, A-505, A-506, A-507, A-508, A-509

E. SUB-SUBS

1. Sub-sub bids are required for this Section. Sub-Bidders shall include the appropriate information for the list of sub sub-bid Class of Work noted below in this paragraph. NOT APPLICABLE

2. If the Filed Sub-Bidder customarily performs the above Work with its own workforce, the Sub-Bidder should list its own name and trade and leave the dollar amount blank.

3. If the Filed Sub-Bidder does not customarily perform the Classes of Work with its own workforce, the Sub-Bidder should list the name of the contractor performing the work, the trade and insert a dollar amount.

END OF SECTION

SECTION 05 50 00

METAL FABRICATIONS
(Filed Sub Bid Required as Part of Section 05 01 00)

PART 1 - GENERAL

1.01 SUMMARY

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 1 – GENERAL REQUIREMENTS, which are hereby made a part of this Section of the Specifications.

B. This Section specifies items and assemblies fabricated from structural steel shapes and other materials as shown and specified.

C. **Work in this Section is included as part of the work in Section 05 01 00**.

1.02 RELATED SECTIONS

A. Section 01 73 29, CUTTING AND PATCHING.

B. Section 03 30 00, CAST IN PLACE CONCRETE.

C. Section 04 20 01, UNIT MASONRY.

D. Section 05 51 00, METAL STAIRS.

E. Section 09 90 10, PAINTING.

F. Section 13 34 19, PRE-ENGINEERED BUILDING.

1.03 REFERENCES

A. American Society of Mechanical Engineers (ASME):
   1. B18.6.1-97 – Wood Screws.
   2. B18.2.2-87 (R2010) – Square and Hex Nuts.

B. ASTM International (ASTM):
   1. A36/A36M-14 – Structural Steel.
   2. A47-99 (R2014) – Malleable Iron Castings.
   3. A48-03 (R2012) – Gray Iron Castings.
   4. A53-12 – Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
   5. A123-15 – Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

6. A240/A240M-15 – Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessels and for General Application.
7. A269-15 – Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
8. A307-14 – Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
9. A391/A391M-07 (R2015) – Grade 80 Alloy Steel Chain.
10. A786/A786M-15 – Rolled Steel Floor Plate.
11. B221-14 – Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes.
12. B456-11 – Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium.
13. B632-08 – Aluminum-Alloy Rolled Tread Plate.
14. C1107-13 – Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
15. D635 - Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position.
16. D3656-13 – Insect Screening and Louver Cloth Woven from Vinyl-Coated Glass Yarns.
17. E84 - Surface Burning Characteristics of Building Materials.
18. F436-16 – Hardened Steel Washers.
19. F468-06 (R2015) – Nonferrous Bolts, hex Cap Screws, Socket Head Cap Screws and Studs for General Use.
20. F593-13 – Stainless Steel Bolts, Hex Cap Screws, and Studs.
21. F1667-15 – Driven Fasteners: Nails, Spikes and Staples.

C. American Welding Society (AWS):
   1. D1.1-15 – Structural Welding Code Steel
   2. D1.2-14 – Structural Welding Code Aluminum.
   3. D1.3-18 – Structural Welding Code Sheet Steel.

D. National Association of Architectural Metal Manufacturers (NAAMM):
   1. AMP 521-01 (R2012) – Pipe Railing Manual.
   2. AMP 600-06 – Metal Finishes Manual.
   3. MBG 531-09 (R2017) – Metal Bar Grating Manual.
   4. MBG 532-09 – Heavy Duty Metal Bar Grating Manual.

E. Structural Steel Painting Council (SSPC) / Society of Protective Coatings:
   1. SP 1-15 – No.1, Solvent Cleaning.
   2. SP 2-04 – No. 2, Hand Tool Cleaning.
   3. SP 3-04 – No. 3, Power Tool Cleaning.

F. Federal Specifications (Fed. Spec.):
   1. RR-T-650E – Treads, Metallic and Nonmetallic, Nonskid.

1.04 SUBMITTALS

A. Submit in accordance with Section 01 33 00, SUBMITTALS.

B. Shop Drawings:
   1. Each item specified, showing complete detail, location in the Project, material and size of components, method of joining various components and assemblies, finish, and location, size and type of anchors.
   2. Mark items requiring field assembly for erection identification and furnish erection drawings and instructions.
   3. Provide templates and rough-in measurements as required.
   4. Guardrails and Handrails:
      a. Show members, sizes and thickness, anchorage locations and accessory items.
      b. Include calculations stamped by a structural engineer registered in the state of Massachusetts.

C. Furnish setting drawings and instructions for installation of anchors to be preset into concrete and masonry work, and for the positioning of items having anchors to be built into concrete or masonry construction.

D. Literature: Manufacturer's complete product data and specifications for all prefabricated items and shop primer paints.

1.05 QUALITY ASSURANCE

A. Each manufactured product shall meet, as a minimum, the requirements specified, and shall be a standard commercial product of a manufacturer regularly presently manufacturing items of type specified.

B. Each product type shall be the same and be made by the same manufacturer.

C. Assembled product to the greatest extent possible before delivery to the site.

D. Include additional features, which are not specifically prohibited by this specification, but which are a part of the manufacturer's standard commercial product.

E. Fabricator shall have a minimum of five years documented experience demonstrating successful work of this type.

PART 2 - PRODUCTS

2.01 DESIGN CRITERIA

A. In addition to the dead loads, design fabrications to support the following live loads unless otherwise specified.

B. Guardrails and Handrails: 50 pounds per linear foot and 200 pounds concentrated load in accordance with 780 CMR 9th edition.

2.02 MATERIALS

A. Structural Steel: ASTM A36.

B. Stainless Steel: ASTM A240, Type 302 or 304.

C. Aluminum, Extruded: ASTM B221, Alloy 6063-T5 unless otherwise specified. For structural shapes use alloy 6061-T6 and alloy 6061-T4511.

D. Floor Plate:
   1. Steel: ASTM A786.
   2. Aluminum: ASTM B632.

E. Steel Pipe (Bollard): ASTM A53:
   1. Galvanized for exterior locations.
   2. Type S, Grade A unless specified otherwise.
   3. NPS (inside diameter) as shown.

F. Cast-Iron: ASTM A48, Class 30, commercial pattern.

G. Malleable Iron Castings: ASTM A47.

H. Stainless Steel Tubing: ASTM A269, Type 302 or 304.

I. Extruded Structural Pipe and Tube: ASTM B429.

J. Extruded Bars, Rods, Shapes and Tubes: ASTM B221.

K. Rolled or Cold-Finished Bars, Rods and Wire: ASTM B211.

L. Primer Paint: As specified in Section 09 90 01, PAINTING.

M. Modular Channel Units:
   1. Factory fabricated, channel shaped, cold formed sheet steel shapes, complete with fittings bolts and nuts required for assembly.
   2. Form channel within turned pyramid shaped clamping ridges on each side.
   3. Provide case hardened steel nuts with serrated grooves in top edges designed to be inserted in the channel at any point and be given a quarter turn so as to engage the

channel clamping ridges. Provide each nut with a spring designed to hold the nut in place.
4. Factory finish channels and parts with oven baked primer when exposed to view. Channels fabricated of ASTM A525, G90 galvanized steel may have primer omitted in concealed locations. Finish screws and nuts with zinc coating.
5. Fabricate snap-in closure plates to fit and close exposed channel openings of not more that 0.0125 inch thick stainless steel.

N. Grout: ASTM C1107, pourable type.

O. Low-Emitting Materials: Paints and coatings shall comply with the testing and product requirements of the California Department of Public Health's "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.03 HARDWARE

A. Rough Hardware:
1. Furnish rough hardware with a standard plating, applied after punching, forming and assembly of parts; galvanized, cadmium plated, or zinc-coated by electro-galvanizing process. Galvanized G90 where specified.
2. Use G90 galvanized coating on ferrous metal for exterior work unless non-ferrous metal or stainless steel is used.

B. Fasteners:
1. Bolts with Nuts:
   a. ASME B18.2.2.
   b. ASTM A307 for 60,000 psi tensile strength bolts.
   c. ASTM F468 for nonferrous bolts.
   d. ASTM F593 for stainless steel.
2. Screws: ASME B18.6.1.
3. Washers: ASTM F436, type to suit material and anchorage.
4. Nails: ASTM F1667, Type I, style 6 or 14 for finish work.

2.04 FABRICATION GENERAL

A. Material:
1. Use material as specified. Use material of commercial quality and suitable for intended purpose for material that is not named or its standard of quality not specified.
2. Use material free of defects of defects which could affect the appearance or service ability of the finished product.

B. Sizes:
   1. Size and thickness of members as shown.
   2. When size and thickness is not specified or shown for an individual part, use size and thickness not less than that used for the same component on similar standard commercial items in accordance with established shop methods.

C. Connections:
   1. Except as otherwise specified, connections may be made by welding, riveting or bolting.
   2. Field riveting will not be approved.
   3. Design size, number and placement of fasteners, to develop a joint strength of not less than the design value.
   4. Holes, for rivets and bolts: Accurately punched or drilled and burrs removed.
   5. Size and shape welds to develop the full design strength of the parts connected by welds and to transmit imposed stresses without permanent deformation or failure when subject to service loads.
   6. Use rivets and bolts of materials selected to prevent corrosion (electrolysis) at bimetallic contacts. Plated or coated material will ne be approved.
   7. Use stainless steel connectors for removable members machine screws or bolts.

D. Fasteners and Anchors:
   1. Use methods for fastening or anchoring metal fabrications to building construction as shown or specified.
   2. Where fasteners and anchors are not shown, design the types, size, location and spacing to resist the loads imposed without deformation of members or causing failure of the anchor or fastener, and suit the sequence of installation.
   3. Use material and finish of the fasteners compatible with the kinds of materials which are fastened together and their location in the finished work.
   4. Fasteners for securing metal fabrications to new construction only, may be by use of threaded or wedge type inserts or by anchors for welding to the metal fabrication for installation before the concrete is placed or as masonry is laid.
   5. Fasteners for securing metal fabrications to existing construction or new construction may be expansion bolts, toggle bolts, power actuated drive pins, welding, self drilling and tapping screws or bolts.

E. Workmanship:
   1. General:
      a. Fabricate items to design shown.
      b. Furnish members in longest lengths commercially available within the limits shown and specified.
      c. Fabricate straight, true, free from warp and twist, and where applicable square and in same plane.
      d. Provide holes, sinkages, and reinforcement shown and required for fasteners and anchorage items.
      e. Provide openings, cut-outs, and tapping holes for attachment and clearances required for work of other trades.

f. Prepare members for the installation and fitting of hardware.
g. Cut openings in gratings and floor plates for the passage of ducts, sumps, pipes, conduits and similar items. Provide reinforcement to support cut edges.
h. Fabricate surfaces and edges free from sharp edges, burrs and projections which may cause injury.

2. Welding:
   a. Weld in accordance with AWS.
   b. Welds shall show good fusion, be free from cracks and porosity and accomplish secure and rigid joints in proper alignment.
   c. Where exposed in the finished work, continuous weld for the full length of the members joined and have depressed areas filled and protruding welds finished smooth and flush with adjacent surfaces.
   d. Finish welded joints to match finish of adjacent surface.
3. Joining:
   a. Miter or butt members at corners.
   b. Where frames members are butted at corners, cut leg of frame member perpendicular to surface, as required for clearance.
4. Anchors:
   a. Where metal fabrications are shown to be present in concrete, weld 1-1/4 by 1/8 inch steel strap anchors, 6 inches long with 1 inch hooked end, to back of member at 2 feet on center, unless otherwise shown.
   b. Where metal fabrications are shown to be built into masonry use 1-1/4 by 1/8 inch steel strap anchors, 10 inches long with 2 inch hooked end, welded to back of member at 2 feet on center, unless otherwise shown.
5. Cutting and Fitting:
   a. Accurately cut, machine and fit joints, corners, copes, and miters.
   b. Fit removable members to be easily removed.
   c. Design and construct field connections in the most practical place for appearance and ease of installation.
   d. Fit pieces together as required.
   e. Fabricate connections for ease of assembly and disassembly without use of special tools.
   f. Joints firm when welded.
   g. Conceal joining, fitting and welding on exposed work as far as practical.
   h. Do not show rivets and screws prominently on the exposed face.
   i. The fit of components and the alignment of holes shall eliminate the need to modify component or to use exceptional force in the assembly of item and eliminate the need to use other than common tools.

F. Finish:
1. Finish exposed surfaces in accordance with NAAMM AMP 500 Metal Finishes Manual.
2. Aluminum: NAAMM AMP 501.
   a. Mill finish, AA-M10, as fabricated, use unless specified otherwise.
   b. Clear anodic coating, AA-C22A41, chemically etched medium matte, with Architectural Class 1, 0.7 mils or thicker.

c. Colored anodic coating, AA-C22A42, chemically etched medium matte with Architectural Class 1, 0.7 mils or thicker.
d. Painted: AA-C22R10.

3. Steel and Iron: NAAMM AMP 504.
   a. Zinc coated (Galvanized): ASTM A123, G90 unless otherwise noted.
   b. Surfaces exposed in the finish work:
      1) Finish smooth rough surfaces and remove projections.
      2) Fill holes, dents and similar voids and depressions with epoxy type patching compound.
   c. Shop Prime Painting:
      1) Surfaces or Ferrous Metal:
         1. Items not specified to have other coatings.
         2. Galvanized surfaces specified to have prime paint.
         3. Remove all loose mill scale, rust, and paint, by hand or power tool cleaning as defined in SSPC-SP2 and SP3.
         4. Clean of oil, grease, soil and other detrimental matter by use of solvents or cleaning compounds as defined in SSPC-SP1.
         5. After cleaning and finishing apply one coat of primer as specified in Section 09 90 01, PAINTING.
      2) Non Ferrous Metals: Comply with NAAMM-500 Series.
4. Stainless Steel: NAAMM AMP-504 Finish No. 4.
5. Chromium Plating: ASTM B456, satin or bright as specified, Service Condition No. SC2.

G. Protection:
   1. Insulate aluminum surfaces that will come in contact with concrete, masonry, plaster, or metals other than stainless steel, zinc or white bronze by giving a coat of heavy-bodied alkali resisting bituminous paint or other approved paint in shop.
   2. Spot prime all abraded and damaged areas of zinc coating which expose the bare metal, using zinc rich paint on hot-dip zinc coat items and zinc dust primer on all other zinc coated items.

2.05 STEEL RAILINGS AND GUARDS

A. In addition to the dead load design railing assembly to support live load specified.

B. Fabrication General:
   1. Provide continuous welded joints, dressed smooth and flush.
   2. Standard flush fittings, designed to be welded, may be used.
   3. Exposed threads will not be approved.
   4. Form handrail brackets to size and design shown.
   5. Exterior Post Anchors.
      a. Fabricate tube or pipe sleeves with closed ends or plates as shown.
      b. Where inserts interfere with reinforcing bars, provide flanged fittings welded or threaded to posts for securing to concrete with expansion bolts.

c. Provide heavy pattern sliding flange base plate with set screws at base of pipe or tube posts. Base plates are not required on pipe sleeves where ornamental railings occur.

6. Interior Post Anchors.
   a. Provide flanged fittings for securing fixed posts to floor with expansion bolts, unless shown otherwise.
   b. Weld of thread flanged fittings to post at base.
   c. For securing removable posts to floor, provide close fitting sleeve insert or inverted flange base plate with stud bolts or rivets concrete anchor welded to the base plate.
   d. Provide sliding flange base plate on posts secured with set screws.
   e. Weld flange base plate to removable posts set in sleeves.

C. Handrails:
   1. Close free ends of rail with flush metal caps welded in place except where flanges for securing to walls with bolts as shown.
   2. Make provisions for attaching handrail brackets to wall, posts, and handrail as shown.

D. Steel Pipe Railings:
   1. Fabricate of steel pipe with welded joints.
   2. Number and space of rails as shown.
   3. Space posts for railings not over 4 feet on center between end posts.
   4. Form handrail brackets from malleable iron.
   5. Fabricate removable sections with posts at end of section.
   6. Removable Rails:
      a. Provide “U” shape brackets at each end to hold removable rail as shown. Use for top and bottom horizontal rail when rails are joined together with vertical members.
      b. Secure rail to brackets with 3/8 inch stainless steel through bolts and nuts at top rail only when rails joined with vertical members.
      c. Continuously weld brackets to post.
      d. Provide slotted bolt holes in rail bracket.
      e. Weld bolt heads flush with top of rail.
      f. Weld flanged fittings to post where posts are installed in sleeves.

2.06 STEEL BOLLARDS

A. Steel bollards shall be Schedule 80 hot-dip galvanized steel pipe. Provide concrete filled pipe as indicated on Drawings.
   1. Steel: Free of surface blemishes and complying with the following.
      a. Standard-weight steel pipe complying with ASTM A53, or electric-resistance-welded pipe complying with ASTM A135.

b. Exposed Surfaces: Polished, sanded, or otherwise finished; all surfaces smooth, free of burrs, barbs, splinters, and sharpness; all edges and ends rolled, rounded, or capped.

2. Galvanizing: Provide the following protective zinc coating applied to components after fabrication.
   a. Zinc-Coated Tubing: External, zinc with organic overcoat, consisting of a minimum of 0.9 oz/sq.ft. of zinc after welding, a chromate conversion coating, and a clear, polymer film. Internal, same as external or consisting of 81 percent zinc pigmented coating, not less than 0.3 mil thick.
   b. Hot-Dip Galvanizing: According to ASTM A123/A123M, ASTM A153/A153M, or ASTM A924/A924M.

B. Metal Finishes:
   1. Shop Painting:
      a. Prime and paint with two finish coats. Color to be yellow.
      b. Galvanized metal assemblies shall be given a shop coat of epoxy primer.
      c. Immediately before shop painting, remove all rust, loose mill scale, dirt, weld flux, weld splatter, and other foreign material with wire brushes and/or steel scrapers. Commercial blast clean in accordance with SSPC SP6. Remove all grease and oil by use of solvent recommended by paint manufacturer.
      d. Apply paint by spray process in strict accordance with manufacturer's printed instructions to uniform thickness recommended by manufacturer. Apply thoroughly and evenly and work well into corners and joints taking care to avoid sags and runs.
      e. Do Not paint surfaces to be embedded in concrete, or to be welded in the field. After field welds are complete, grind smooth and flush, thoroughly clean and then apply specified primer over all unprimed surfaces in the field by brush or roller.
      f. After erection, sand smooth and retouch all portions of the shop coats chipped or damaged during erection.

C. Bollard Sleeve: HDPE and LDPE polyethylene.
   1. Size: 8-7/8 inch diameter by 72 inches long, or as otherwise indicated.
   2. Color: Yellow.
   3. Tape: Red.

PART 3 - EXECUTION

3.01 INSTALLATION GENERAL

A. Set work accurately, in alignment and where shown, plumb, level, free of rack and twist, and set parallel or perpendicular as required to line and plane of surface.

B. Items to be set into concrete or masonry.
   1. Provide temporary bracing for such items until concrete or masonry is set.

2. Place in accordance with setting drawings and instructions.
3. Build strap anchors, into masonry as work progresses.

C. Field weld in accordance with AWS.
1. Design and finish as specified for shop welding.
2. Use continuous weld unless specified otherwise.

D. Install anchoring devices and fasteners as shown and as necessary for securing metal fabrications to building construction as specified. Power actuated drive pins may be used except for removable items and where members would be deformed or substrate damaged by their use.

E. Spot prime all abraded and damaged areas of zinc coating as specified and all abraded and damaged areas of shop prime coat with same kind of paint used for shop priming.

F. Isolate aluminum form dissimilar metals and from contact with concrete and masonry materials as required to prevent electrolysis and corrosion.

G. Secure escutcheon plate with set screw.

3.02 STEEL RAILINGS AND GUARDS

A. Steel Posts:
1. Secure fixed posts to concrete with expansion bolts through flanged fittings except where sleeves are shown with pourable grout.
2. Install sleeves in concrete formwork.
3. Set post in sleeve and pour grout to surface. Apply beveled bead of urethane sealant at perimeter of post or under flange fitting as specified in Section 07 90 00, SEALANTS AND CAULKING – on exterior posts.
4. Secure removable posts to concrete with either machine screws through flanged fittings which are secured to inverted flanges embedded in and set flush with finished floor, or set posts in close fitting pipe sleeves without grout.
5. Secure sliding flanged fittings to posts at base with set screws.
6. Secure fixed flanged fittings to concrete with expansion bolts.
7. Secure posts to steel with welds.

B. Anchor to Walls:
1. Anchor rails to concrete or solid masonry with machine screws through flanged fitting to steel plate.
   a. Anchor steel plate to concrete or solid masonry with expansion bolts.
   b. Anchor steel plate to hollow masonry with toggle bolts.
2. Anchor flanged fitting with toggle bolt to steel support in frame walls.

C. Removable Rails:

1. Rest rails in brackets at each end and secure to bracket with stainless steel bolts and nuts where part of a continuous railing.
2. Rest rail posts in sleeves where not part of a continuous railing. Do not grout posts.

3.03 INSTALLATION OF STEEL PIPE BOLLARD

A. Set bollards vertically in concrete piers. Compressive strength of concrete piers shall be 4,000 psi.

3.04 CLEANING AND ADJUSTING

A. Adjust movable parts including hardware to operate as designed without binding or deformation of the members centered in the opening or frame and, where applicable, contact surfaces fit tight and even without forcing or warping the components.

B. Clean after installation exposed prefinished and plated items and items fabricated from stainless steel, aluminum and copper alloys, as recommended by the metal manufacture and protected from damage until completion of project.

END OF SECTION

SECTION 05 51 00

METAL STAIRS
(Filed Sub Bid Required as Part of Section 05 01 00)

PART 1 - GENERAL

1.01 SUMMARY

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 1 – GENERAL REQUIREMENTS, which are hereby made a part of this Section of the Specifications.

B. Steel closed riser stairs filled with concrete, and bar grating perforated tread and landing system.

C. **Work in this Section is included as part of the work in Section 05 01 00**.

1.02 RELATED SECTIONS

A. Section 03 30 00, CAST IN PLACE CONCRETE.

B. Section 04 20 01, UNIT MASONRY.

C. Section 05 50 00, METAL FABRICATIONS.

D. Section 09 90 10, PAINTING.

E. Section 13 34 19, PRE-ENGINEERED BUILDING.

1.03 REFERENCES

A. American Society of Mechanical Engineers (ASME):
   1. B18.2.1-12 – Square, Hex, Heavy Hex, and Askew Head Bolts and Hex, Heavy Hex, Hex Flange, Lobed Head, and Lag Screws (Inch Series).
   2. B18.2.3.8M-81 (R2005) – Metric Heavy Lag Screws.
   3. B18.6.1-81 (R2008) – Wood Screws (Inch Series).
   4. B18.6.3-13 – Machine Screws, Tapping Screws, and Metallic Drive Screws (Inch Series).
   5. B18.6.5M-10 – Metric Thread Forming and Thread Cutting Tapping Screws.
   6. B18.6.7-10 – Metric Machine Screws.
   7. B18.22M-81 (R2010) – Metric Plain Washers.
   8. B18.21.1-09 – Washers: Helical Spring-Lock, Tooth Lock, and Plain Washer (Inch Series).

B. ASTM International (ASTM):
   1. A36 – Standard Specification for Carbon Structural Steel.
   2. A53 – Standard Specification for Pipe, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
   3. A500 – Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
   4. A513 – Standard Specification for Electric-Resistance-Welded Carbon and Alloy Steel Mechanical Tubing.
   5. A786 – Standard Specification for Hot-Rolled Carbon, Low-Alloy, High-Strength Low-Alloy and Alloy Steel Floor Plates.
   6. A1008 – Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened and Bake Harden Able.
   7. A1011 – Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High Strength Low-Alloy with Improved Formability, and Ultra-High Strength.
   8. C1107 – Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
   9. D635 - Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in Horizontal Position.
   10. E84 - Surface Burning Characteristics of Building Materials.
   11. E94 – Standard Guide for Radiographic Examination Using Industrial Radiographic Fim.
   12. E142 – Method for Controlling Quality of Radiographic Testing.
   13. E164 – Standard Practice for Contact Ultrasonic Testing of Weldments.
   14. E165 – Standard Practice for Liquid Penetrant Examination for General Industry.
   15. E709 – Standard Guide for Magnetic Particle Testing.

C. American Welding Society (AWS):
   1. D1.1 Structural Welding Code – Steel.
   2. D1.3 Structural Welding Code – Sheet Steel.

D. American National Standard Institute (ANSI):
   1. A117.1 – Accessible and Usable Buildings and Facilities Standards.

E. The Society for Protective Coatings (SSPC):
   1. SP2 Hand Tool Cleaning.
   2. SP3 Power Tool Cleaning.

F. National Association of Architectural Metal Manufacturers (NAAMM):
   1. SP2 Hand Tool Cleaning.
   2. SP3 Power Tool Cleaning.

G. National Ornamental and Miscellaneous Metals Association:
   1. Weld Finish Type(s).

H. American Institute of Steel Construction (AISC):
   1. AISC Manual of Practice.

I. Massachusetts Building Code: 780 CMR, 9th edition.

1.04 SUBMITTALS

A. Submit in accordance with Section 01 33 00, SUBMITTALS.

B. Product Data. Submit specified products as follows:

   1. Manufacturer's product data.
   2. Manufacturer's installation instructions.

C. Shop Drawings. Indicate the following information on Shop Drawings:
   1. Stair plans, elevations, details, methods of installation and anchoring.
   2. Show members, sizes and thickness, anchorage locations and accessory items.
   3. Include calculations stamped by a Professional Engineer registered in the state of Massachusetts.

1.05 QUALITY ASSURANCE

A. Calculations: Provide professionally prepared calculations and certification performance of this work, signed and sealed by a Professional Engineer registered in the state of Massachusetts. Perform structural design of the stair including supports for the metal stair frame.

B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M and AWS D1.3/D1.3M.

PART 2 - PRODUCTS

2.01 DESIGN CRITERIA

A. Structural Performance of Stairs: Stairs shall withstand the following structural loads without exceeding the allowable design working stress of materials, including anchors and connections. Apply each load to produce the maximum stress in each component.
   1. Treads and Platforms of Metal Stairs: Capable of withstanding a uniform load of 100 psf and concentrated load of 300 lbf applied on an area of 4 square inches. Concentrated and uniform loads need not be assumed to act concurrently.

2. Stair Framing: Capable of withstanding stresses resulting from loads specified, in addition to stresses resulting from railing system loads.
3. Limit deflection of treads, platforms and framing members to L/240.

B. Structural Performance of Handrails and Guardrails: Handrails and guardrails shall withstand the following structural loads without exceeding the allowable design working stress of materials, including handrails, guardrails, anchors and connections.
1. Top of Guardrail: Capable of withstanding a concentrated load of 200 lbf applied in any direction and a uniform load of 50 psf applied in any direction. Concentrated and uniform loads need not be assumed to act concurrently.

2.02 MATERIALS

A. Steel Pipe: ASTM A53, Standard Weight, zinc coated.

B. Steel Grating: Metal bar type grating NAAMM BG.

C. Sheet Steel: ASTM A1008/A1008M.

D. Structural Steel: ASTM A36/A36M.

E. Steel Floor Plate: ASTM A786/A786M.

F. Steel Decking: Form from zinc coated steel conforming to ASTM A653/A653M, with properties conforming to AISI S100 Specification for the Design of Cold-Formed Steel Structural Members.

G. Steel Plate: ASTM A1011/A1011M.

H. Iron Castings: ASTM A48/A48M, Class 30.

I. Malleable Iron Castings: ASTM A47/A47M.

J. Grout: Ready mixed, non-shrink, non-metallic high strength grout flowable consistency, conforming to ASTM C1107 with minimum compressive strength of 8,000 pounds per square inch at 28 days.

K. Shop Paint: Provide paint for all ferrous metals in accordance with Section 09 90 01, PAINTING.

2.03 FABRICATION GENERAL

A. Fasteners:
1. Conceal bolts and screws wherever possible.

2. Use countersunk heads on exposed bolts and screws with ends of bolts and screws dressed flush after nuts are set.
3. Galvanized zinc-coated fasteners in accordance with ASTM A153/A153M and used for exterior applications or where built into exterior walls or floor systems. Select fasteners for the type, grade, and class required for the installation of steel stair items.
4. Standard/regular hexagon-head bolts and nuts be conforming to ASTM A307, Grade A.
5. Square-head lag bolts conforming to ASME B18.2.3.8M, ASME B18.2.1.
6. Machine screws cadmium-plated steel conforming to ASME B18.6.7M, ASME B18.6.3.
7. Wood screws, flat-head carbon steel conforming to ASME B18.6.5M, ASME B18.6.1.
8. Plain Washers, round, general-assembly-grade, carbon steel conforming to ASME B18.22M, ASME B18.21.1.
9. Lockwashers helical spring, carbon steel conforming to ASME B18.2.1, ASME B18.2.3.8M.

B. Welding:
   1. Structural steel, AWS D1.1/D1.1M, and sheet steel, AWS D1.3/D1.3M.
   2. Where possible, locate welds on unexposed side.
   3. Grind exposed welds smooth and true to contour of welded member.
   4. Remove welding splatter.

C. Remove sharp edges and burrs.

D. Fit stringers to head channel and close ends with steel plates welded in place where shown.

E. Fit face stringer to newel post by tenoning into newel post, or be notching and fitting face stringer to side of newel post where shown.

F. Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges. Ease exposed edges to a radius of approximately 1/32 inch, and bend metal corners to the smallest radius possible without causing grain separation or otherwise impairing the work.

G. Continuously weld corners and seams in accordance with the recommendations of AWS D1.1/D1.1M. Grind smooth exposed welds and flush to match and blend with adjoining surfaces.

H. Form exposed connections with hairline joints that are flush and smooth, using concealed fasteners whenever possible. Use exposed fasteners of the type indicated of, if not indicated, use Phillips flathead (countersunk) screws or bolts.

I. Provide and coordinate anchorage of the type indicated with the supporting structure. Fabricate anchoring devices, space as indicated and required to provide adequate support for the intended use of the work.

J. Use hot-rolled steel bars for work fabricated for bar stock unless work is indicated or specified as fabricated from cold-finished or cold-rolled stock.

K. Shop Prime Painting: Prepare surface, and apply primer as specified for ferrous metals in Section 09 90 01, PAINTING.

2.04 RAILINGS

A. Fabricate railings, including handrails, from steel pipe.
   1. Connections may be standard fittings designed for welding, or coped or mitered pipe with full welds.
   2. Wall handrails are provided under Section 05 50 00, METAL FABRICATIONS.

B. Return ends of handrail to wall and close free end.

C. Provide standard terminal castings where fastened to newel.

D. Space intermediate posts not over 4 feet on center between end posts.

E. Fabricate handrail bracket from malleable iron.

F. Provide standard terminal fittings at ends of post and rails.

2.05 STEEL GRATING STAIRS

A. Provide treads, platforms, railings, stringers and other supporting members as shown.

B. Fabricate steel grating platforms in accordance with requirements of NAAMM MBG 531-09.

C. Treads shall be pre-fabricated steel cross bar with checkered plate nosing and integral toe kick. Treads shall be nominal 1-3/4 inch high by 12-1/8 inches wide with 2-1/2 inch high side mounting plates.

D. Fabricate stringers, headers, and other supporting members from structural steel.

E. Construct newel posts of steel tubing having wall thickness not less than 3/16 inch, with forged steel caps and drops.

PART 3 - EXECUTION

3.01 STAIR INSTALLATION

A. Provide hangers and struts required to support the loads imposed.

B. Perform job site welding and bolting as specified for shop fabrication.

C. Set stairs and other members in position and secure to structure as shown.

D. Install stairs plumb, level and true to line.

E. Provide steel closure plate to fill gap between stringer and surrounding wall. Weld and apply primer, ready to accept paint finish.

3.02 RAILING INSTALLATION

A. Install standard terminal fittings at ends of posts and rails.

B. Secure brackets, posts and rails to steel by welds, and to masonry or concrete with expansion sleeves and bolts, except secure posts at concrete by setting in sleeves filled with commercially non-shrink grout.

C. Set rails horizontal and parallel to rake of stairs to within 1/8 inch in 12 feet.

D. Set posts plumb and aligned to within 1/8 inch in 12 feet.

3.03 FIELD PRIME PAINTING

A. When installation is complete, clean and touch-up damaged paint surfaces in accordance with Section 09 90 01, PAINTING.

3.04 QUALITY ASSURANCE TESTING AND INSPECTION

A. The Owner will engage an independent testing and inspection agency to inspect high-strength bolted connections and welded connections and to perform tests and prepare test reports.

B. Testing agency shall conduct and interpret tests, state in each report whether test specimens comply with requirements, and specifically state any deviation therefrom.

C. Provide access for testing agency to places where structural steel work is being fabricated or produced so that required inspection and testing can be accomplished.

D. Testing agency may inspect steel at plant before shipment.

E. Testing and Inspection Agency will perform the following types of testing and inspection:
   1. Shop Quality Control Program: Review the fabricator's in house quality control program including procedures, testing and inspection. Report findings to the Architect.
   2. Field-Bolted Connections: Inspect in accordance with AISC specifications.
   3. Field Welding: Inspect and test during erection of structural steel as follows:
      a. Review welder's certifications and certify welders if required. Conduct inspections and tests as required. Record types and locations of defects found in wok. Record work required and performed to correct deficiencies.
      b. Perform visual inspection of all welds and, at its discretion, inspection utilizing the following more precise measurements.
         1) Ultrasonic Inspection: ASTM E164.
         2) Liquid Penetrant Inspection: ASTM E165.
         3) Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not acceptable.
         4) Radiographic Inspections: ASTM E94 and ASTM E142; minimum quality level "2-2T."
      c. Test full penetration welds using ultrasonic inspection methods in accordance with ASTM E164.

F. Correct deficiencies in structural steel work that inspections and laboratory test reports have indicated to be not in compliance with requirements. Perform additional tests, at contractor's expense, as necessary to reconfirm any noncompliance of original work and to show compliance of corrected work.

END OF SECTION

SECTION 06 10 00

ROUGH CARPENTRY

PART 1 - GENERAL

1.01 SUMMARY

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 1 – GENERAL REQUIREMENTS, which are hereby made a part of this Section of the Specifications.

B. This section specifies wood blocking, framing, sheathing, furring, nailers, sub-flooring, rough hardware, and light wood construction.

1.02 RELATED SECTIONS

A. Section 03 30 00, CAST IN PLACE CONCRETE.

B. Section 04 20 01, UNIT MASONRY.

C. Section 06 20 00, FINISH CARPENTRY AND MILLWORK.

D. Section 07 60 00, FLASHING AND SHEET METAL.

E. Section 08 11 00, STEEL DOORS AND FRAMES.

F. Section 08 40 00, FIBERGLASS REINFORCED PANEL (FRP) DOORS AND FRAMES.

G. Section 08 54 13, FIBERGLASS WINDOWS.

H. Section 08 91 00, LOUVERS.

I. Section 09 21 16, GYPSUM BOARD SYSTEM.

J. Section 09 22 00, NON-LOAD BEARING FRAMING SYSTEMS.

K. Section 10 28 00, TOILET AND BATH ACCESSORIES.

1.03 REFERENCES

A. American Forest and Paper Association (AFPA):

1. NDS-15 – National design Specification for Wood Construction.
2. WCD1-01 – Details for Conventional Wood Frame Construction.

B. American Institute of Timber Constructions (AITC):
1. A190.1-07 – Structural Glue Laminated Timber.

C. American Society of Mechanical Engineers (ASME):
1. B18.2.1-12 (R2013) – Square and Hex Bolts and Screws.
2. B18.2.2-10 – Square and Hex Nuts.
3. B18.6.1-81 (R2008) – Wood screws.

D. American Plywood Association (APA):
1. E30-11 – Engineered Wood Construction Guide.

E. ASTM International (ASTM):
1. A653/A653M-13 – Steel Sheet Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot Dip Process.
2. C954-11 – Steel Drill Screws for the Application of Gypsum Board or Metal Plaster Bases to Steel Studs from 0.033 inch to 0.112 inch in Thickness.
3. C1002-14 – Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Metal Studs.
4. D198-14 – Test Methods of Static Tests of Lumber in Structural Sizes.
5. D2344/D2344M – Test Method for Short-Beam Strength of Polymer Matrix Composite Materials and Their Laminates.
6. D2559-12a – Adhesives for Structural Laminated Wood Products for Use Under Exterior (Wet Use) Exposure Conditions.
7. D3201 – Standard Test Method for Hydroscopic Properties of Fire-Retardant Wood and Wood-Base Products.
8. D3498-03 (R2011) – Adhesives for Field-Gluing Plywood to Lumber Framing for Floor Systems.
9. D5516 – Standard Test Method for Evaluating the Flexural Properties of Fire-Retardant Treated Softwood Plywood Exposed to Elevated Temperatures.
10. D5664 – Standard Test Method for Evaluating the Effects of Fire-Retardant Treatments and Elevated Temperatures on Strength Properties of Fire-Retardant Treated Lumber.
11. D6108-13 – Test Method for Compressive Properties of Plastic Lumber and Shapes.
12. D6109-13 – Test Methods for Flexural Properties of Unreinforced and Reinforced Plastic Lumber and Related Products.
13. D6111-13a – Test Method for Bulk Density and Specific Gravity of Plastic Lumber and Shapes by Displacement.
14. D6112-13 – Test Methods for Compressive and Flexural Creep and Creep-Rupture of Plastic Lumber and Shapes.
15. D6305 – Standard Practice for Calculating Bending Strength Design Adjustment Factors for Fire Retardant Treated Plywood Roof Sheathing.

16. D6841 – Standard Practice for Calculating Treatment Adjustment Factors for Fire Retardant Treated Lumber.
17. E84 – Standard Test Method for Surface Burning Characteristics of Building Materials.
18. E2786 – Extended Duration Surface Burning Characteristics of Building Materials.
19. E119 – Fire Tests of Building Construction and Materials.
20. F844-07a (R2013) – Washers, Steel, Plan (Flat) Unhardened for General Use.
21. F1667-13 – Nails, Spikes and Staples.

F. American Wood Protection Association (AWPA):
   1. AWPA Book of Standards.
   2. E12 – Standard Method of Determining the Corrosion of Metal in Contact with Wood.
   3. M4 – Standard for Care of Preservative Treated Wood Products.
   4. P50 – Standard for Fire Retardant FR-2 (FR-2).
   5. T1 – Use Category System: Processing and Treatment Standard.
   6. U1 – Use Category System: User Specifications for Treated Wood.

G. Commercial Item Description (CID):
   1. A-A-55615 – Shield, Expansion (Wood Screw and Lag Bolt Self Threaded Anchors).

H. Forest Stewardship Council (FSC):
   1. FSC-STD-01-001 (ver. 4-0) – FSC Principals and Criteria for Forest Stewardship.

I. Environmental Protection Agency (EPA):
   1. 40 CFR 59 (2014) – National Volatile Organic Compound Emission Standards for Consumer and Commercial Products.

J. U.S. Department of Commerce Product Standard (PS):
   1. PS 1-95 – Construction and Industrial Plywood.
   2. PS 20-10 – American Softwood Lumber Standard.

1.04 SUBMITTALS

A. Submit in accordance with Section 01 33 00, SUBMITTALS.

B. Shop Drawings: Show framing connection details, fasteners, connections and dimensions.

C. Manufacturer's Literature and Data:
   1. Submit data for lumber, panels, hardware and adhesives.
   2. Submit data for wood-preservative treatment from chemical treatment manufacturer and certification from treating plants that treated materials comply

with requirements. Indicate type of preservative used and net amount of preservative retained.
3. Submit data for fire retardant treatment from chemical treatment manufacturer and certification by treatment plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
4. Products for receiving waterborne treatment, submit statement that moisture content materials was reduced to levels specified before shipment to project site.

D. Manufacturer's certificate for unmarked lumber.

1.05 QUALITY ASSURANCE

A. Installer: A firm with a minimum of three year's experience in the type of work required by this section.

B. Fire Retardant Treated Wood.
1. Wood Treatment Plant Qualifications: Wood treatment plant experienced in performing work of this section licensed by Fire Retardant Chemical Technology.
2. Source Quality: Obtain treated wood products from a single approved source.
3. Fire Retardant Treatment: Mark each piece of plywood and lumber to show compliance with specified standards.
4. Regulatory Requirements: Provide for retardant treatment which complies with the following regulatory requirements:
   a. International Building Code (IBC).
5. Independent Third Party Inspection:
   a. Provide plant inspections.
6. Kiln Dry after Treatment (KDAT): Provide kiln dry material as indicated or required.
   a. Kiln dry after treatment to 19 percent maximum moisture content for lumber and 15 percent for plywood in accordance with AWPA T1, Section H – Subsection 3. Drying Requirements.

1.06 DELIVERY, STORAGE AND HANDLING

A. Protect lumber and other products from dampness both during and after delivery at site.

B. Pile lumber in stacks in such manner as to provide air circulation around surfaces of each piece.

C. Stack plywood and other board products so as to prevent warping.

D. Locate stacks on well drained areas, supported at least 6 inches above grade and cover with well-ventilated sheds having firmly constructed over hanging roof with sufficient end wall to protect lumber from driving rain.

PART 2 - PRODUCTS

2.01 LUMBER

A. Unless otherwise specified, each piece of lumber must bear grade mark, stamp, or other identifying marks indicating grades of material, and rules or standards under which are produced.
   1. Identifying marks are to be in accordance with rule or standard under which material is produced, including requirements for qualifications and authority of the inspection organization, usage of authorized identification, and information included in the identification.
   2. Inspection agency for lumber approved by the Board of Review, American Lumber Standards Committee, to grade species used.

B. Structural Members: Species and grade as listed in the AFPA NDS having design stresses as shown.

C. Lumber Other Than Structural:
   1. Unless otherwise specified, species graded under the grading rules of an inspection agency approved by Board of Review, American Lumber Standards Committee.
   2. Framing Lumber: Minimum extreme fiber stress in bending of 7584 kPa (1100 psi).
   3. Furring, blocking, nailers and similar items 4 inches and narrower Standard grade; and, members 6 inches and wider, Number 2 Grade.

D. Sizes:
   1. Conforming to PS 20.
   2. Size reference are nominal sizes, unless otherwise specified, actual sizes are within manufacturing tolerances allowed by standard under which produced.

E. Moisture Content:
   1. Maximum moisture content of wood products is to be as follows at the time of delivery to site.
      a. Boards and lumber 2 inches and less in thickness: 19 percent or less.
      b. Lumber over 2 inches thick: 25 percent or less.

F. Fire Retardant Pressure Treatment of Lumber and Plywood.
   1. Fire retardant treatment for wood, including roof and floor trusses, roof decks and sheathing; subflooring, beams and purlins, blocking and furring, studs, joists and

paneling, architectural millwork and trim, interior non-load bearing partitions, and exterior load-bearing wall.

a. Lumber: Comply with AWPA U1 UCFA, Type A.
b. Plywood: Comply with AWPA U1, UCFA, Type A.
c. Surface Burning Characteristics: Class A; or flame spread and smoke developed ratings of 25 and 450 respective or less in a test of 30 minutes duration in accordance with IBC section 2303.2.
d. Kiln dry after treatment of 19 percent maximum moisture content for lumber and 15 percent for plywood.

G. Preservative Treatment:
1. Do not treat Heart Redwood and Western Red Cedar.
2. Treat wood members and plywood exposed to weather or in contact with plaster, masonry or concrete, including framing of open roofed structures; sills, sole plates, furring, and sleepers that are less than 24 inches from ground; nailers, edge strips, blocking, crickets, curbs, cant, vent strips and other members provided in connection with roofing and flashing materials.
3. Treat other members specified as preservative treated (PT).
4. Preservative treat by the pressure method complying with AWPA Book use category system standards U1 and T1, except any process involving the use of Chromated Copper Arsenate (CCA) or other agents classified as carcinogenic for pressure treated wood is not permitted.

2.02 PLYWOOD

A. Comply with PS 1.

B. Bear the mark of a recognized association or independent inspection agency that maintains continuing control over quality of plywood which identifies compliance by veneer grade, group number, span rating where applicable, and glue type.

C. Sheathing:
1. Minimum 11/32 inch thick with span rating 24/0 or 15/32 inch thick with span rating for supports 16 inches on center unless specified otherwise.
2. Minimum 19/32 inch thick or span rating of 40/20 or 23/32 inch thick or span rating of 48/24 for supports 24 inches on center.

2.03 ROUGH HARDWARE AND ADHESIVES

A. Anchor Bolts:
1. ASME B18.2.1 and ASME B18.2.2 Galvanized, ½ inch unless shown otherwise.
2. Extend at least 8 inches into masonry or concrete with ends bent 2 inches.

B. Miscellaneous Bolts: C1D A-A-55615; lag bolt, long enough to extend at least 2-1/2 inches into masonry or concrete. Provide ½ inch bolt unless shown otherwise.

C. Washers:
   1. ASTM F844.
   2. Provide zinc or cadmium coated steel or cast iron for washers exposed to weather.

D. Screws:
   1. Wood to Wood: ASME B18.6.1 or ASTM C1002.
   2. Wood to Steel: ASTM C954 or ASTM C1002.

E. Nails:
   1. Size and type best suited for purpose unless noted otherwise. Provide aluminum-alloy nails, plated nails, or zinc-coated nails, for nailing wood work exposed to weather and on roof blocking.
   2. ASTM F1667:
      a. Common: Type I, Style 10.
      b. Concrete: Type I, Style 11.
      c. Barbed: Type I, Style 26.
      d. Underlayment: Type I, Style 25.
      e. Masonry: Type I, Style 27.

F. Adhesive:
   1. D not use adhesives that contain urea formaldehyde.
   2. Heavy duty multipurpose construction adhesive. ASTM D3498 and APA-AFG-01.

G. Backing Plate: Danback Fire-Retardant Treated Wood Backing Plate D16F as manufactured by ClarkDietrich, or approved equal.

PART 3 - EXECUTION

3.01 INSTALLATION OF FRAMING AND MISCELLANEOUS WOOD MEMBERS

A. AFPA WCD1 for nailing and framing unless specified otherwise.

B. Fasteners:
   1. Nails.
      a. Nail in accordance with the Recommended Nailing Schedule as specified in AFPA WCD1. Select nail size and nail spacing sufficient to develop adequate strength for the connection without splitting the member.
      b. Use special nails with framing connectors.
      c. For sheathing and subflooring, select length of nails sufficient to extend 1 inch into supports.

d. Use 8d or larger nails for nailing through 1 inch thick lumber and for toe nailing 2 inch thick lumber.
e. Use 16d or larger nails for nailing through 2 inch thick lumber.

2. Bolts:
   a. Fit bolt heads and nuts bearing on wood with washers.
   b. Countersink bolt heads flush with the surface of nailers.
   c. Embed in concrete and solid masonry or provide expansion bolts. Special bolts or screws designed for anchor to solid masonry or concrete in drilled holes may be used.
   d. Provide toggle bolts to hollow masonry or sheet metal.
   e. Provide bolts to steel over 0.112 inch, 11 gage in thickness. Secure wood nailers to vertical structural steel members with bolts, placed one at ends of nailer and 24 inch intervals between end bolts. Provide clips to beam flanges.
3. Drill Screws to steel less than 0.112 inch thick.
   a. ASTM C1002 for steel less than 0.033 inch thick.
   b. ASTM C954 for steel over 0.033 inch thick.
4. Power actuated drive pins may be provided where practical to anchor to solid masonry, concrete, or steel.
5. Do not anchor to wood plugs or nailing blocks in masonry or concrete. Provide metal plugs, inserts or similar fastening.
6. Screws to Join Wood:
   a. Where shown or option to nails.
   b. ASTM C1002, sized to provide not less than 1 inch penetration into anchorage member.
   c. Spaced same as nails.

C. Blocking Nailers, and Furring:
1. Install furring, blocking, nailers, and grounds where shown.
2. Provide longest lengths practicable.
3. Provide fire retardant treated wood blocking where shown at openings and where shown or specified.
4. Layers of Blocking or Plates:
   a. Stagger ends joints between upper and lower pieces.
   b. Nail at ends and not over 24 inches between ends.
   c. Stagger nails from side to side of wood member over 5 inches in width.

D. Sheathing:
1. Provide plywood or structural-use panels for sheathing.
2. Lay panels with joints staggered, with edge and ends 1/8 inch apart and nailed over bearings as specified.
3. Set nails not less than 3/8 inch from edges.

END OF SECTION

SECTION 06 20 00

FINISH CARPENTRY AND MILLWORK

PART 1 - GENERAL

1.01 SUMMARY

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 1 – GENERAL REQUIREMENTS, which are hereby made a part of this Section of the Specifications.

B. This section specifies interior millwork.
   1. Wood trims, each type.
   2. Plastic laminate finished plywood or particleboard.
   3. PVC trim.
   4. Plastic laminate.
   5. Medium density fiberboard.
   6. Adhesives.
   7. Hardware.

1.02 RELATED SECTIONS

A. Section 06 10 00, ROUGH CARPNETRY.

B. Section 06 61 00, SOLID POLYMER FABRICATIONS.

C. Section 07 90 00, SEALANTS AND CAULKING.

D. Section 09 29 00, GYPSUM BOARD SYSTEMS.

E. Section 09 91 00, PAINTING.

1.03 REFERENCES

A. ASTM International (ASTM):
   1. A36/A36M – Carbon Structural Steel.
   2. A53/A53M – Pipe, Steel, Black and Hot-Dipped Zinc Coated, Welded and Seamless.
   3. A240/A240M-15b – Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Application.
   4. B26/B26M-14e1 – Aluminum-Alloy Sand Castings.

5. B221-14 – Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
6. D570 – Standard Test Method for Water Absorption of Plastics.
7. D638 – Standard Test Method for Tensile Properties of Plastics.
8. D696 – Standard Test Method for Coefficient of Linear Thermal Expansion of Plastics Between -30° and 30°C with a Vitreous Silica Dilatomer.
9. D792 – Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement.
10. D1761 – Standard Test Methods for Mechanical Fasteners in Wood.
11. E84-15b – Surface Burning Characteristics of Building Materials.

B. American Hardboard Association (AHA):
   1. A135.4-04 – Basic Hardboard.

C. Architectural Woodwork Institute (AWI):
   1. AWI-09 – Architectural Woodwork Quality Standards and Quality Certification Program.

D. Builders Hardware Manufacturers Association (BHMA):
   1. A156.9-10 – Cabinet Hardware.
   2. A156.11-14 – Cabinet Locks.
   3. A156.16-13 – Auxiliary Hardware.

E. Federal Specification (Fed. Spec.):
   1. A-A-1922A – Shield Expansion (Calking Anchors, Single Lead).
   2. A-A-1936A – Adhesive, Contact, Neoprene Rubber.
   3. FF-N-836E – Nut, Square, Hexagon, Cap, Slotted, Castle, Knurled, Welding.
   4. FF-S-111D (1) – Screw, Wood (Notice 1 inactive for new design).
   5. MM-L-736C (1) – Lumber, Hardwood.

F. Hardwood Plywood and Veneer Plaster Association (HPVA):
   1. HP1-09 – Hardwood and Decorative Plywood.

G. National Particleboard Association (NPA):
   1. A208.1-09 – Wood Particleboard.

H. National Electrical Manufacturers Association (NEMA):
   1. LD 3-05 – High-Pressure Decorative Laminates.

I. U.S. Department of Commerce, Product Standard (PS):
   1. PS1-07 – Construction and Industrial Plywood.
   2. PS20-10 – American Softwood Lumber Standard.

1.04 SUBMITTALS

A. Submit in accordance with Section 01 33 00, SUBMITTALS.

B. Submittal Drawings:
   1. Show size, configuration, and fabrication and installation details.
   2. Millwork items – half full size scale for sections and details, ¼ inch for elevations and plans.

C. Manufacturer's Literature and Data:
   1. Description of each product.
      a. Finish hardware.
      b. Sinks with fittings.
      c. Electrical components.
   2. List of acceptable sealers for fire retardant materials.
   3. Installation instructions.

D. Samples:
   1. 6 by 12 inches, each type and color.

E. Certificates: Certify each product complies with specifications.
   1. Fire retardant treatment of materials.
   2. Moisture content of materials.

1.05 QUALITY ASSURANCE

A. Fabricator Qualifications:
   1. Regularly fabricates specified products.
   2. Fabricated specified products with satisfactory service on five similar installations for minimum five years.

B. Installer Qualifications:
   1. Regularly installs specified products.
   2. Installed specified products with satisfactory service on five similar installations for minimum five years.

1.06 DELIVERY, STORAGE AND HANDLING

A. Deliver products in manufacturer's original sealed packaging.

B. Marl packaging, legibly. Indicate manufacturer's name or brand, type, color, production run number, and manufacture date.

C. Before installation, return or dispose of products within distorted, damaged, or open packaging.

D. Store products indoors in dry, weathertight, conditioned facility.

E. Protect products from damage during handling and construction operations.

1.07 PROJECT/SITE CONDITIONS

A. Environmental:
   1. Product Temperature: Minimum 70 degrees F for minimum 48 hours before installation.
   2. Work Area Ambient Conditions: HVAC systems are complete, operational, and maintaining facility design operating conditions continuously, beginning 48 hours before installation until occupancy.
   3. Install products when building is permanently enclosed and when wet construction is complete, dried and cured.
   4. Do not install finish lumber or millwork in any room or space where wet process systems such as concrete, masonry, or plaster work is not complete and dry.

B. Field Measurements: Verify field conditions affecting fabrication and installation. Show field measurements on Submittal Drawings.
   1. Coordinate field measurement and fabrication schedule to avoid delay.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Grading and Marking: Factory mark with grade stamp lumber and plywood of inspection agency approved by the Board of Review, American Lumber Standard Committee.

B. Lumber:
   1. Sizes:
      a. Lumber size references, unless otherwise specified, are nominal sizes, and actual sizes within manufacturing tolerances allowed by the standard under which product is produced.
      b. Millwork, standing and running trim, and rails: Actual size as shown or specified.
   2. Hardwood: MM-L-736, species as specified for each item.
   3. Softwood: PS-20, exposed to view appearance grades:
      a. Use C select or D select, vertical grain for transparent finish including stain transparent finish.
      b. Use Prime for painted or opaque finish.

4. Use edge grain Wood members exposed to weather.
5. Moisture Content:
   a. 1-1/4 inches or less nominal thickness: 12 percent on 85 percent of the pieces and 15 percent on the remainder.
   b. Other materials: According to standards under which the products are produced.
6. Fire Retardant Treatment:
   a. Treatment and performance inspection by an independent and qualified testing agency that establishes performance ratings.
   b. Each piece of treated material bear identification of the testing agency and indicate performance according to such rating of flame spread and smoke developed.
   c. Treat wood for maximum flame spread of 25 and smoke developed of 25.
   d. Fire Resistant Softwood Plywood:
      1) Grade A, Exterior, plywood for treatment.
      2) Surface Burning Characteristics: When tested according to ASTM E84.
         1. Flame spread: 0 to 25.
         2. Smoke developed: 100 maximum.
   e. Fire Resistant Hardwood Plywood:
      1) Core: Fire retardant treated softwood plywood.
      2) Hardwood face and back veneers untreated.
      3) Factory seal panel edges.

C. Plywood:
   1. Softwood Plywood: DOC PS1.
      a. Plywood, ½ inch and thicker; minimum five ply construction, except 1-1/4 inch thick plywood minimum seven ply.
      b. Plastic Laminate Plywood Cores:
         1) Exterior Type, and species group.
         2) Veneer Grade: A-C.
      c. Shelving Plywood:
         1) Interior Type, any species group.
         2) Veneer Grade: A-B or B-C.
      d. Other: As specified for item.
   2. Hardwood Plywood: HPVA HP.1.
      a. Species of Face Veneer: As shown or as specified with each particular item.
      b. Grade:
         1) Transparent Finish: Type II (interior) A grade veneer.
         2) Paint Finish: Type II (interior) Sound Grade veneer.
      c. Species and Cut: Plain sliced red oak, rotary cut white birch, or as specified otherwise.

D. Medium Density Fiberboard (MDF):
   1. ASTM D1037-87.
      a. Manufactured predominately from Southern pine fibers and cured with radio frequency RF/steam heat.

b. Properties: Internal bond 115 psi, screw holding (face 350 lbs. and edge 300 lbs.), moisture content 5-6 percent.
c. Thickness: ½ inch, unless otherwise specified.
d. Size: As required for seamless application.

2. ANSI A208.2, Grade MD, made with binder containing no urea formaldehyde.

E. Particleboard: NPA A208.1, Type 1.

F. Plastic Laminate: NEMA LD-3.
1. Exposed Laminate Surfaces including Countertops, and Sides of Cabinet Doors: Grade HGL.
2. Cabinet Interiors Including Shelving: NEMA, CLS as a minimum, with the following:
a. Plastic laminate clad plywood or particleboard.
b. Resin impregnated decorative paper thermally fused to particleboard.
3. Plastic Laminate Covered Wood Tops Backing: Grade HGP.
4. Postformed Surafces: Grade HGP.

G. Stainless Steel: ASTM A240, Type 302 or 304.

H. Cast Aluminum: ASTM B26.

I. Extruded Aluminum: ASTM B221.

2.02 PRODUCTS

A. PVC Trim:
1. General: Solid PVC trim and moldings, install sizes and profiles as shown.
a. Density: ASTM D792, 0.55 g/cm³.
b. Water Absorption: ASTM D570, 0.4%.
c. Tensile Strength: ASTM D638, 1808 psi.
d. Nail Hold: ASTM D1761, 35 lbf/in of penetration.
e. Screw Hold: ASTM D1761, 680 lbf/in of penetration.
f. Coefficient of Linear Expansion: ASTM D696, 5.5x10-5 in/in/F.
2. Warranty: 25 year against deterioration.

B. Adhesive:
1. Do not use adhesives that contain urea formaldehyde.
2. Use adhesives that meet the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.03 PLASTIC LAMINATE FACED CABINETS

A. Quality Standard: Unless otherwise indicated, comply with "Architectural Woodwork Standards" for grades of cabinets indicated for construction, finishes, installation, and other requirements.

B. Type of Construction: Frameless.

C. Door and Drawer Front Style: Flush overlay.
   1. Reveal Dimension: ½ inch.

D. Laminate Cladding for Exposed Surfaces:
   1. Horizontal Surfaces: Grade HGL.
   2. Postformed Surfaces: Grade HGP.
   3. Vertical Surfaces: Grade HGL.
   4. Edges: Grade HGL.

E. Materials for Semiexposed Surfaces:
   1. Edges of Plastic Laminate Shelves: Grade HGL.
   2. Drawer Sides and Backs: Solid hardwood lumber.
   3. Drawer Bottoms: Hardwood plywood.

F. Dust Panels: ¼ inch plywood or tempered hardboard above compartments and drawers unless located directly under tops.

G. Drawer Construction: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.

H. Join subfronts, backs, and sides with glued rabbeted joints supplemented by mechanical fasteners.

2.04 FABRICATION

A. General:
   1. AWI Custom Grade for interior millwork.
   2. Finish woodwork, free from pitch pockets.
   3. Trim, standard stock molding and members of same species, except where special profiles are shown.
   4. Plywood, minimum ½ inch, unless otherwise shown on Drawings or specified.
   5. Edges of members in contact with concrete or masonry having a square corner caulking rebate.
   6. Fabricate members less than 14 feet in length from one piece of lumber, back channeled and molded as shown.
   7. Fabricate interior trim and items of millwork to be painted from jointed, built-up, or laminated members, unless otherwise shown on Drawings or specified.

8. Plastic Laminate Work:
   a. Factory glued to either a plywood or particle board core, thickness as shown on Drawings or specified.
   b. Cover exposed edges with plastic laminate, except where aluminum, stainless steel, or plastic molded edge strips are shown on Drawings or specified. Use plastic molded edge strips on ¾ inch thick or thinner core material.
   c. Provide plastic backing sheet on underside of countertops, vanity tops, thru-wall counter and sills including back splashes and end splashes of countertops.
   d. Use backing sheet on concealed large panel surface when decorative face does not occur.

B. Plastic Laminate Faced Cabinets:
   1. Fabricate architectural cabinets to dimensions, profiles, and details indicated.
   2. Complete fabrication, including assembly and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
      a. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements before disassembling for shipment.
   3. Shop-cut openings to maximum extent possible to receive hardware, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs. For decorative plastic llaminates, comply with manufacturer's written fabrication instructions.

2.05 ACCESSORIES

A. Hardware:
   1. Rough Hardware:
      a. Provide rough hardware with a standard plating, applied after punching, forming and assembly of parts; galvanized, cadmium plated, or zinc-coated by electric-galvanizing process. Galvanized where specified.
      b. Fasteners:
         1) Bolts with Nuts: FF-N-836.
         2) Expansion Bolts: A-A-1922A.
         3) Screws: FF-S-111.
   2. Finish Hardware:
      a. Cabinet Hardware:
         1) Door/Drawer Wire Pulls: 4" brushed chrome, B02011. Manufacturer: Hafele #116.39.464, or approved equal.
         2) Drawer Slides: B05051 for drawers over 6 inches deep, B05052 for drawers 3 to 6 inches deep, and B05053 for drawers less than 3 inches

deep. Manufacturer: Hafele #FE-9903 self-closing drawer runner, or approved equal.

3) Concealed Hinges: B1601, minimum 110 degree opening. Manufacturer: Hafele #329.17.507 Duomatic hinge and #329.66.61 mounting clip, or approved equal.

2.06 COUNTER SUPPORT BRACKET

A. Material: Fabricate components from extruded aluminum sections complying with ASTM B221, 6063-T5 alloy and temper.

B. Factor Applied Finish: Exposed aluminum surfaces shall be free of scratches and other serious blemishes and be factory finished with primer suitable for field painting.

C. Support brackets fabricated by welding miter cut extruded aluminum sections, grinding and deburring sharp edges and welds, drilling holes for field attachment, and factory finishing.

D. L-shaped bracket fabricated from aluminum T sections designed for supporting 24 inch deep counter. Model EH-1818 as manufactured by Rangie Corp., or approved equal.

PART 3 - EXECUTION

3.01 PREPARATION

A. Examine and verify substrate suitability for product installation.

B. Protect existing construction and completed work from damage.

C. Clean substrates. Remove contaminants capable of affecting subsequently installed product's performance.

3.02 INSTALLATION

A. Installation General:
   1. Prime millwork receiving transparent finish and back-paint concealed surfaces.
   2. Fasten trim with fine finishing nails, screws, or glue as required.
   3. Set nails for putty stopping. Provide washers under bolt heads where no other bearing plate occurs.
   4. Seal cut edges with fire retardant treated wood materials with a certified acceptable sealer.

5. Coordinate with plumbing and electrical work for installation of fixtures and service connections in millwork items.
6. Plumb and level items unless shown otherwise.
7. Nail finish at each blocking, lookout, or other nailer and intermediate points; toggle or expansion bolt in place where nails are not suitable.
8. Apply adhesive uniformly for full contact.

B. Plastic Laminate Faced Cabinets:
1. Assemble cabinets and complete fabrication at Project site to extent that it was not completed in the shop.
2. Anchor cabinets to anchors or blocking built in or directly attached to substrates. Secure with wafer-head cabinet installation screws.
3. Install cabinets level, plumb, and true to line to a tolerance of 1/8 inch in 96 inches using concealed shims.
   a. Scribe and cut cabinets to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
   b. Install cabinets without distortion so doors and drawers fit openings and are accurately aligned. Adjust hardware to center doors and drawers to openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.
   c. Fasten wall cabinets through back, near top and bottom and at ends not more than 16 inches on center with No. 10 wafer-head screws sized for not less than 1-1/2 inch penetration into wood framing, blocking, or hanging strips.

3.03 CLEANING

A. Remove excess adhesive before adhesive sets.

B. Clean exposed surfaces. Remove contaminants and stains.

C. Touch up damaged finishes.
1. Repair painted surfaces with touch up primer.

3.04 PROTECTION

A. Protect finish carpentry from traffic and construction operations.

B. Cover finish carpentry with reinforced kraft paper, and plywood or hardboard.

C. Remove protective materials immediately before acceptance.

D. Repair damage.

END OF SECTION

SECTION 06 61 00

SOLID POLYMER FABRICATIONS

PART 1 - GENERAL

1.01 SUMMARY

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 1 – GENERAL REQUIREMENTS, which are hereby made a part of this Section of the Specifications.

B. This section specified solid polymer countertops and backsplash.

1.02 RELATED SECTIONS

A. Section 06 10 00, ROUGH CARPENTRY.

B. Section 06 20 00, FINISH CARPENTRY AND MILLWORK.

C. Section 07 90 00, SEALANTS AND CAULKING.

1.03 REFERENCES

A. ANSI/NPA A208.2-09 – Medium Density Fiberboard (MDF) For Interior Application.

B. ASTM International (ASTM):
1. C920-14a – Standard Specification for Elastomeric Joint Sealants.
2. D638-10 – Standard Test Method for Tensile Properties of Plastics.
3. D785-08 – Standard Test Method for Rockwell Hardness of Plastics and Electrical Insulating Materials.
4. D790-10 – Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
5. D5420-10 – Standard Test Method for Impact Resistance of Flat, Rigid Plastic Specimen by Means of a Striker Impacted by a Failing Weight (Gardner Impact).
6. E84-14 – Standard Test Method for Surface Burning Characteristics of Building Materials.
7. E228-11 – Standard Test Method for Linear Thermal Expansion of Solid Materials with a Push-Rod Dilatometer.
8. G21-13 – Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.

9. G22-76(96) – Standard Practice for Determining Resistance of Plastics to Bacteria.
10. G155-13 – Standard Practice for Operating Xenon Arc Light Apparatus for Exposure of Non-Metallic Materials.

C. CSA B45.5-11/IAPMO Z124-2011 – Plastic Plumbing Fixtures.

D. NFPA 255-06 – Standard Method of Test of Surface Burning Characteristics of Building Materials

E. NSF/ANSI 51-07 – Food Equipment Materials.

F. SCAQMD Rule 1168 – Adhesive and Sealant Application (amended January 2005).

G. Underwriters Laboratory (UL):
1. 723 – Standard for Test for Surface Burning Characteristics of Building Materials.
2. 2824 – GREENGUARD Certification Program, Method for Measuring Microbial Resistance from Various Sources Using Static Environmental Chambers.

1.04 SUBMITTALS

A. Submit in accordance with Section 01 33 00, SUBMITTALS.

B. Product Data: Description including solid surface sheets, sinks, bowls, fabrication information and compliance with specified performance requirements. Submit product data with resistance to list of chemicals.

C. Shop Drawings: Submit drawings for work in this section. Indicate plans, sections, dimensions, component sizes, edge details, thermosetting requirements, fabrication details, attachment provisions, sizes of furring, blocking, including concealed blocking and coordination requirements with adjacent work. Show locations and sizes of cutouts and holes for plumbing fixtures, faucets, soap dispensers, waste receptacles and other items to be installed in solid surface.

D. Samples: Submit actual samples of surfacing materials to illustrate full range of colors, patterns, and finish available.

E. Test and Evaluation Reports: Submit flammability test reports and food preparation zone certification/listing conforming compliance with NSF/ANSI 51.

F. Operational and Maintenance Data:
1. Submit manufacturer’s care and maintenance data, including repair and cleaning instructions. Include in Project closeout documents.
2. Provide a commercial care and maintenance kit and video. Review maintenance procedures and warranty details with Owner upon completion.

1.05 DELIVERY, STORAGE AND HANDLING

A. Delivery and Acceptance Requirements: Deliver no components to Project site until areas are ready for installation.

B. Storage and Handling Requirements:
   1. Store components indoors prior to installation.
   2. Handle materials to prevent damage to finished surfaces.

PART 2 - PRODUCTS

2.01 MANUFACTURER

A. Acceptable Manufacturers: Dupont surfaces, or approved equal.

2.02 MATERIALS

A. Solid Surface:
   1. Non-porous, homogeneous material maintaining the same composition throughout the part with a composition of acrylic polymer, aluminum trihydrate filler and pigment; not coated, laminated or of composite construction.
   2. Flammability: Class 1 and A when tested to UL 723.
   3. Food Equipment Material Compliance: Food Zone to NSF/ANSI 51.
      a. Ensure material has minimum physical and performance properties specified under "Performance/Design Criteria."
      b. Ensure superficial damage to a depth of 0.010" is repairable by sanding and polishing.
   4. Performance/Design Criteria:

	Property	**Requirement**	**Test**
a.	Tensile Strength	6000 psi min	ASTM D638
b.	Tensile Modulus	1.5 x 10^6 psi min	ASTM D638
c.	Tensile Elongation	0.4% min	ASTM D638
d.	Flexural Strength	10000 psi min	ASTM D790
e.	Flexural Modulus	1.2 x 10^6 psi min	ASTM D790
f.	Hardness	>85-Rockwell "M" scale min	ASTM D785
g.	Thermal Expansion	2.2 x 10^{-5} in/in/°F	ASTM E228
h.	Fungi and Bacteria	Does not support microbial growth	ASTM G21 and G22
i.	Microbial Resistance	Highly resistant to mold growth	UL 2824
j.	Ball Impact	No fracture – ½ lb Ball: 6 mm slab – 36" drop 12 mm slab – 144" drop	NEMA LD3, Method 3.8
k.	Weatherability	ΔE*95<5 in 1,000 hours	ASTM G155
l.	Flammability		ASTM E84,

		NFPA 255, and UL 723
m. Flame Spread	<25	
n. Smoke Developed	<25	
o. Class	A	NFPA 101

B. Adhesive for Bonding to Other Products: One component silicone ASTM C920.

C. Sealant: A standard mildew-resistant, FDA/UL recognized silicone color matched sealant.

2.03 COMPONENTS

A. Countertops:
1. Material Thickness: Nominal ½ inch material thickness on MDF backing with layout as shown on Drawings.
2. Size: Countertops shall be dimension and profile as shown on Drawings.
3. Color match silicone adhesive at joints.
4. Accessories: Solid 0.400 inch backsplash.
5. Warranty: 25 years.
6. Color: Corian "Canvas", or approved equal.

B. Fabrication:
1. Fabricate components in shop to greatest extent practical to sizes and shapes indicated, in accordance with approved shop drawings and solid polymer manufacturer requirements. Form joints between components using manufacturer's standard joint adhesive without conspicuous joints. Provide factory cutouts for plumbing fittings and bath accessories as indicated on Drawings.
2. Where indicated, thermoform corners and edges or other objects to shapes and sizes indicated on Drawings, prior to seaming and joining. Cut components larger than finished dimensions and sand edges to remove nicks and scratches. Heat entire component uniformly prior to forming.
3. Ensure no blistering, whitening, and cracking of components during forming.
4. Fabricate backsplashes from solid surfacing material with optional radius cove where counter and backsplashes meet as indicated on Drawings.
5. Fabricate joints between components using manufacturer's standard joint adhesive. Ensure joints are inconspicuous in appearance and without voids. Attach 2 inch wide reinforcing strip of solid polymer material under each joint.
6. Provide holes and cutouts for plumbing and bath accessories as indicated on Drawings.
7. Rout and finish component edges to a smooth, uniform finish. Rout cutouts, then sand edges smooth. Repair or reject defective or inaccurate work.
8. Fabricate Tolerances:
   a. Variation in Component Size: +/- 1/8 inch.

b. Location of Openings: +/- 1/8 inch from indicated locations.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verification of Conditions:
   1. Examine substrates and conditions, with fabricator present for compliance with requirements for installation tolerances and other conditions affecting performance of work. Proceed with installation only after unsatisfactory conditions have been corrected.
   2. Verify actual site dimensions and location of adjacent materials prior to commencing work.
   3. Examine cabinets upon which counter tops are to be installed. Verify cabinets are level to within 1/8 inch in 10 feet.
   4. Notify Architect in writing of any conditions which would be detrimental to installation.

B. Evaluation and Assessment: Commencement of work implies acceptance of previously completed work.

3.02 INSTALLATION

A. Install components plumb, level, rigid, scribed to adjacent finishes in accordance with reviewed shop drawings and product installation details.

B. Fabricate field joints using manufacturer's recommended adhesive, with joints being inconspicuous in finished work. Exposed joints/seams are not permitted. Keep components and hands clean when making joints. Reinforce field joints as specified herein. Cut and finish component edges with clean, sharp returns.

C. Route radii and contours to template. Anchor securely to base component or other supports. Align adjacent components and form seams to comply with manufacturer's written recommendations using adhesive in color to match work. Carefully dress joints smooth, remove surface scratches and clean entire surface.

D. Install countertops with nor more than 1/8 inch sag, bow or other variation from a straight line.

E. Adhere undermount/submount/bevel mount sink/bowls to countertop using manufacturer's recommended adhesive and mounting hardware.

F. Adhere topmount sinks/bowls to countertop using manufacturer recommended adhesives and color-coordinated silicone sealant.

G. Seal between wall and components with joint sealant as specified herein and in Section 07 90 00, SEALANTS AND CAULKING, as applicable.

H. Provide backsplashes and endsplashes as indicated on Drawings. Adhere to countertops using a standard color-coordinated silicone sealant. Adhere applied sidesplashes to countertops using a standard color-coordinated silicone sealant. Provide coved backsplashes and sidesplashes at walls and adjacent millwork. Fabricate radius cover at intersection of counters with backsplashes to dimensions shown on reviews shop drawings. Adhere to countertops using manufacturer's standard color-coordinated joint adhesive.

I. Keep components and hands clean during installation. Remove adhesives, sealants and other stains. Ensure components are clean on date of Substantial Completion.

J. Coordinate connections of plumbing fixtures.

3.03 REPAIR

A. Repair minor imperfections and cracked seams and replace areas of severely damaged surfaces in accordance with manufacturer's technical bulletins.

3.04 FIELD QUALITY CONTROL

A. Non-Conforming Work: Replace damaged work which cannot be satisfactorily repaired, restored or cleaned, to satisfaction of Architect at no cost to Owner.

3.05 CLEANING

A. Remove excess adhesive and sealant from visible surfaces.

B. Clean surfaces in accordance with manufacturer's "Care and Maintenance Instructions."

3.06 PROTECTION

A. Provide protective coverings to prevent physical damage or staining following installation for duration of Project.

B. Protect surfaces from damage until date of Substantial Completion.

END OF SECTION

SECTION 07 21 00

BUILDING INSULATION

PART 1 - GENERAL

1.01 SUMMARY

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 1 – GENERAL REQUIREMENTS, which are hereby made a part of this Section of the Specifications.

B. This section specifies thermal and sound attenuation insulation for buildings.

1.02 RELATED SECTIONS

A. Section 03 30 00, CAST IN PLACE CONCRETE.

B. Section 04 20 01, UNIT MASONRY.

C. Section 07 27 26, AIR BARRIER.

D. Section 07 41 00, METAL ROOF PANELS.

E. Section 07 42 00, METAL WALL PANELS.

F. Section 09 21 16, GYPSUM BOARD SYSTEM.

G. Section 09 22 00, NON-LOAD BEARING FRAMING SYSTEMS.

H. Section 13 34 19, PRE-ENGINEERED BUILDING.

1.03 REFERENCES

A. ASTM International (ASTM):
   1. C165 – Standard Test Method for Measuring Compressive Properties of Thermal Insulations.
   2. C167 – Standard Test Method for Thickness and Density of Blanket or Batt Thermal Insulations.
   3. C272 – Standard Test Method for Water Absorption of Core Materials for Sandwich Construction.
   4. C303 – Standard Test Method for Dimensions and Density of Preformed Block and Board-Type Thermal Insulation.

5. C518 – Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
6. C578 – Standard Specification for Rigid Cellular Polystyrene Thermal Insulation.
7. C612 – Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
8. C665 – Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
9. C795 – Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
10. C1104/C1104M – Standard Test Method for Determining the Water Vapor Sorption of Unfaced Mineral Fiber Insulation.
11. C1338 – Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facings.
12. D1621 – Standard Test Method for Compressive Properties of Rigid Cellular Plastics.
13. D2126 – Standard Test Method for Response of Rigid Cellular Plastics to Thermal and Humid Aging.
14. D2863 – Standard Test Method for Measuring the Minimum Oxygen Concentration to Support Candle-Like Combustion of Plastics (Oxygen Index).
15. D4716 – Standard Test Method for Determining the (In-lane) Flow Rate per Unit Width and Hydraulic Transmissivity of a Geosythetic Using a Constant Head.
16. E84 – Standard Test Method for Surface Burning Characteristics of Building Materials.
17. E96/E96M – Standard Test Method for Water Vapor Transmission of Materials.
18. E136 – Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750 Degrees C.
19. E228 – Standard Test Method for Linear Thermal Expansion of Solid Materials With a Push-Rod Dilatometer.
20. E2178 – Standard Test Method for Air Permeance of Building Materials.

B. Underwriters' Laboratories (UL):
1. CAN/ULC S102 – Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
2. CAN/ULC S114 – Standard Method of Test for Determination of Non-Combustibility of Building Materials.

1.04 SUBMITTALS

A. Submit in accordance with Section 01 33 00, SUBMITTALS.

B. Submittal Drawings:
1. Show insulation type, thickness, and R-value for each location.
2. Indicate installation methods.

C. Manufacturer's Literature and Data:

1. Insulation description of each product.
2. Adhesive, tape and accessories of each type.

D. Certificates: Stating the type, thickness and "R" value (thermal resistance) of the insulation to be installed.

1.05 QUALITY ASSURANCE

A. Each insulation board must be labeled with manufacturer's name, product brand name, ASTM material specification reference, and identification of the third party inspection agency use for building code qualification.

1.06 DELIVERY, STORAGE AND HANDLING

A. Deliver materials in manufacturer's original packaging.

B. Store and protect products in accordance with manufacturer's instructions. Store in a dry area and protect from water, direct sunlight, flame, and ignition sources. Do not install insulation that has been damaged or wet.
   1. In the event board insulation becomes wet, wipe dry prior to installation.

1.07 PROJECT/SITE CONDITIONS

A. Temperature: Install insulation within range of ambient and substrate temperatures recommended by the manufacturer. Do not apply insulation to a damp or wet substrate.
B. Field Conditions: Do not install insulation in snow, rain, fog or mist. Do not install insulation or auxiliary materials when the temperature of substrate surfaces and surrounding air temperatures are below those recommended by the manufacturer.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Foam Plastic Board Insulation For Use Under Slab, Interior Foundation Perimeter, and Exterior Wall Cavity:
   1. Extruded Polystyrene Board Insulation: Comply with ASTM C578, Type VI, 40 psi minimum compressive strength, 1.80 lb/cu. ft. Owens Corning Formular® 400, or approved equal.
      a. Thermal Resistance: R-5.0 per inch of thickness, with 90% lifetime limited warranty on thermal resistance. 180 day real-time aging as mandated by ASTM C578, measured per ASTM C518 at mean temperature of 75F.

b. Blowing Agent Formulation: Zero ozone depleting.
c. Edge Condition: Square.
d. Surface Burning Characteristics (ASTM E84): Flame spread less than 25, smoke developed less than 450, certified by independent third party such as Underwriters Laboratory (UL).
e. Indoor Air Quality: Compliance certified by independent third party such as GREENGUARD Indoor Air Quality Certified® and/or GREENGUARD Children and Schools Certified.
f. Recycled Content: Minimum 20%, certified by independent third party such as Scientific Certification Systems.
g. Panel Size: 4 ft. wide by 8 ft. long, thickness as indicated on Drawings.

B. Mineral Wool Insulation for Use in Above Grade Cavity Walls/Rainscreens:
1. Mineral Wool Insulation: Non-combustible, lightweight, water-repellent, rigid insulation board with rigid upper surface to ASTM C612 Type IVB. Rockwool CavityRock, or approved equal.
a. Size: 16 by 48 inches.
b. Thickness: As indicated on Drawings.
c. Density:
1) 1.5 inches and below: 5.3 lb/ft³ to ASTM C303.
2) 2 inches and below: 4.4 lb/ft³ to ASTM C303.
3) 2.5 inches and above:
1. Outer layer: 6.2 lb/ft³ to ASTM C303.
2. Inner layer: 4.1 lb/ft³ to ASTM C303.
d. Fire Performance:
1) Non-combustibility: ASTM E136.
2) Surface Burning Characteristics: ASTM E84.
1. Flame spread: 0.
2. Smoke developed: 0.
e. Thermal Resistance: 4.3 h ft² degrees F/Btu to ASTM C518.
f. Water Vapor Permeance: 27.2 Perm minimum.
g. Moisture Absorption: 1 percent maximum to ASTM C1104/C1104M.
h. Fungi Resistance: Zero mold growth to ASTM C1338.
i. Corrosive Resistance:
1) Steel to ASTM C665: Pass.
2) Stainless steel to ASTM C795: Pass.

C. Mineral Wool Acoustical Fire Batts (AFB) for Interior Partitions.
1. Acoustical Fire Batts (AFB): Non-combustible, lightweight, semi-rigid stone wool batt insulation to CAN/ULC S702, Type 1, that provides fire resistance to ASTM E136 and a sound control to ASTM E90 and ASTM E423. Rockwool AFB, or approved equal.
a. 16 by 48 inches.
b. Thickness: As indicated on Drawings.
c. Fire Performance:
1) Non-combustibility: ASTM E136.

2) Surface Burning Characteristics: ASTM E84.
   1. Flame spread: 0.
   2. Smoke developed: 0.

d. Acoustical Performance:
   1) Airborne sound transmission loss: To ASTM E90.
   2) Rating sound insulation: To ASTM E413.
   3) Impedance and absorption of acoustic materials: To ASTM E1050.
e. Air Erosion Velocity: 1,000 ft/m maximum to UL 181.
f. Thermal Resistance: To ASTM C518.
g. Corrosive Resistance:
   1) Steel to ASTM C665: Pass.
   2) Stainless to ASTM C795: Pass.

2.02 ACCESSORIES

A. Adhesives, Sealants and Primers: Adhesives, sealants and primers shall be compatible with the insulations being used.

B. Mechanical fasteners in accordance with insulation manufacturer's written recommendations.

C. Insulation Clips: In accordance with manufacturer's written recommendations.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions under which the insulation will be applied, with installer present, for compliance with requirements. Verify that surfaces and conditions are suitable prior to commencing work of this Section. Do not proceed with installation until unsatisfactory conditions have been corrected.

B. Review requirements for sequencing of installation of all wall assembly components.

3.02 INSTALLATION

A. Below-Grade, Slab-On-Grade Insulation:
   1. Lay insulation boards over vapor retarder sheet, cutting to size as necessary. Adjacent insulation boards shall be installed with joints staggered. Subsequent layers of insulation board shall be installed over the lower layer with board joints staggered.
   2. Use sealant to seal gaps between the insulation board and the perimeter foundation wall. Apply sealant as recommended by sealant manufacturer.

B. Cavity Wall Insulation:
   1. Install insulation to maintain continuity of thermal protection to building elements and spaces.
   2. Fit insulation closely around electrical boxes, pipes, ducts, frames and other objects in or passing through insulation.
   3. Keep insulation minimum 3 inches from heat emitting devices such as recessed light fixtures, and minimum 2 inches from sidewalls of chimneys and vents.
   4. Install insulation in accordance with manufacturer's written instructions.
   5. Install insulation board with adhesives or mechanical fasteners in accordance with manufacturer's written recommendations.

3.03 FIELD QUALITY CONTROL

A. Owner's Testing and Inspection: Cooperate with Owner's testing agency. Allow access to work areas and staging. Notify Owner's testing agency in writing of schedule for work of this section to allow sufficient time for testing and inspection. Daily inspection and texting may be required. Do not cover Work of this Section until testing and inspection is accepted.

3.04 PROTECTION

A. Protect insulation from damage during installation and remainder of construction period, according to manufacturer's written instructions.
   1. Coordinate with installation of insulation to ensure exposure periods do not exceed the manufacturer's recommendations.

END OF SECTION

SECTION 07 27 26

AIR BARRIER

PART 1 - GENERAL

1.01 SUMMARY

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 1 – GENERAL REQUIREMENTS, which are hereby made a part of this Section of the Specifications.

B. This Section includes the following:
   1. Materials and installation methods for sheet-applied, vapor impermeable air barrier membrane system located in the non-accessible part of the wall.
   2. Materials and installation methods to bridge and seal air leakage pathways in roof and foundation junctions, window and door openings, control and expansion joints, masonry ties, piping and other penetrations through the wall assembly.

1.02 RELATED SECTIONS

A. Section 03 30 00, CAST IN PLACE CONCRETE.

B. Section 04 20 01, UNIT MASONRY.

C. Section 07 41 00, METAL ROOF PANELS.

D. Section 07 42 00, METAL WALL PANELS.

E. Section 08 36 13, SECTIONAL DOORS.

F. Section 08 40 00, FIBERGLASS REINFORCED PANEL (FRP) DOORS AND FRAMES.

G. Section 08 54 13, FIBERGLASS WINDOWS.

H. Section 08 91 00, LOUVERS.

I. Section 13 34 19, PRE-ENGINEERED BUILDING.

1.03 REFERENCES

A. ASTM International (ASTM):

1. C1193 – Guide for Uses of Joint Sealants.
2. D412 – Standard Test Methods for Rubber Properties in Tension.
3. D570 – Standard Test Method for Water Absorption of Plastics.
4. D1004 – Standard Test Method for Tear Resistance (Graves Tear) of Plastic Film and Sheeting.
5. D1876 – Test Method for Peel Resistance of Adhesives.
6. D1938 – Standard Test Method for Tear-Propagation Resistance (Trouser Tear) of Plastic Film and Thin Sheeting by a Single-Tear Method.
7. D1970 – Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection.
8. D4258 – Practice for Surface Cleaning Concrete for Coating.
9. D4263 – Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method.
10. D4541 – Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Tears.
11. E96 – Test Methods for Water Vapor Transmission of Materials.
12. E154 – Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover.
13. E1186 – Practice for Air Leakage Site Detection in Building Envelopes and Air Retarder Systems.
14. E2178 – Standard Test Method for Air Permeance of Building Materials.
15. E2357 – Standard Test Method for Determining Air Leakage of Air Barrier Assemblies.

B. National Fire Protection Associations (NFPA):
   1. 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. Air Barrier Assembly: The collection of air barrier materials and auxiliary materials applied to an opaque wall, including joints and junctions to abutting construction, to control air movement through the wall.

1.05 PERFORMANCE REQUIREMENTS

A. General: Air barrier shall be capable of performing as a continuous vapor-impermeable air barrier and as a liquid-water drainage plane flashed to discharge to the exterior incidental condensation and water penetration. Air barrier assemblies shall be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.

B. The building envelope shall be designed and constructed with a continuous air barrier to control air leakage into, or out of the conditioned space. An air barrier shall also be provided for interior partitions between conditioned space and space designed to maintain temperature or humidity levels which differ from those in the conditioned space by more than 50% of the difference between the conditioned space and design ambient conditions. The air barrier shall have the following characteristics:
   1. It must be continuous, with all joints made airtight.
   2. It shall have an air permeability not to exceed 0.004 cfm/sq. ft. under a pressure differential of 0.3 in. water (1.57 psf) (equal to 0.02 L/s x sq. m @ 75 Pa), when tested in accordance with ASTM E2178.
   3. It shall have an air permeability not to exceed 0.04 cfm/sq. ft. under a pressure differential of 0.3 in. water (1.57 psf) (equal to 0.2 L/s x sq. m @ 75 Pa), when tested in accordance with ASTM E2357.
   4. It shall be capable of withstanding positive and negative combined design wind, fan and stack pressures on the envelope without damage or displacement, and shall transfer the load to the structure. It shall not displace adjacent materials under full load.
   5. It shall be durable or maintainable.
   6. The air barrier shall be joined in an airtight and flexible manner to the air barrier material of adjacent systems, allowing for the relative movement of systems due to thermal and moisture variations and creep. Connection shall be made between:
      a. Foundation and walls.
      b. Walls and windows or doors.
      c. Different wall systems.
      d. Wall and roof.
      e. Wall and roof over unconditioned space.
      f. Walls, floors and roof across construction, control and expansion joints.
      g. Walls, floors and roof to utility, pipe and duct penetrations.
   7. All penetrations of the air barrier and paths of air infiltration/exfiltration shall be made airtight.

1.06 SUBMITTALS

A. Submit in accordance with Section 01 33 00, SUBMITTALS.

B. Product Data: Include manufacturer's written instructions for evaluating, preparing, and treating substrate; technical data; and tested physical and performance properties of air barrier.

C. Shop Drawings: Show locations and extent of air barrier. Include details for substrate joints and cracks, counterflashing strip, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.
   1. Include details of interfaces with other materials that form part of the air barrier.
   2. Include details of mockup.

D. Samples: Submit representative samples of the following for approval:
   1. Sheet-applied membrane.
   2. Self-adhered transition membrane.
   3. Self-adhered through wall flashing.

E. Product Certificates: For air barriers, certifying compatibility of air barrier and accessory materials with project materials that connect to or that come in contact with the air barrier, signed by product manufacturer.

F. Qualification data: For Applicator.

G. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for air barriers, submit certified test report showing compliance with requirements specified for ASTM E2178.

H. Warranty: Submit sample warranty identifying the terms and conditions stated in 1.10.

1.07 QUALITY ASSURANCE

A. Manufacturer: Air barrier systems shall be manufactured and marketed by a firm with a minimum of 20 years experience in the production and sales of waterproofing and air barriers. Manufacturers proposed for use, but not named in these specifications shall submit evidence of ability to meet all requirements specified, and include a list of projects of similar design and complexity completed within the past five years.

B. Source Limitations: Obtain primary air barrier material and all air barrier assembly materials through one source from a single manufacturer. Should Project require vapor permeable and a vapor impermeable air barrier on the same Project, obtain vapor permeable and vapor impermeable air barriers and through wall flashing from one source from a single manufacturer.

C. Applicator Qualifications: A firm experienced in applying air barrier materials 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.

D. Mockups: Before beginning installation of air barrier, provide air barrier work for wall assembly mockups, incorporating backup wall construction, external cladding, window, door frame and sill, insulation, and flashing to demonstrate surface preparation, crack and joint treatment, and sealing of gaps, terminations, and penetrations of air barrier membrane.
   1. Coordinate construction of mockup to permit inspection by Owner's testing agency of air barrier before external insulation and cladding is installed.

2. If Architect determines mockups do not comply with requirements, reconstruct mockups and apply air barrier until mockups are approved.

E. Pre-Installation Conference: A pre-installation conference shall be held prior to commencement of field operations to establish procedures to maintain optimum working conditions and to coordinate this work with related and adjacent work. Pre-installation conference shall include the Contractor, installer, Architect, and system manufacturer's field representative. Agenda for meeting shall include but not be limited to the following:
   1. Review of submittals.
   2. Review of surface preparation, minimum curing period and installation procedures.
   3. Review of special details and flashings.
   4. Sequence of construction, responsibilities and schedule for subsequent operations.
   5. Review of mock-up requirements.
   6. Review of inspection, testing, protection and repair procedures.

1.08 DELIVERY, STORAGE AND HANDLING

A. Deliver materials and products in labeled packages. Store and handle in strict compliance with manufacturer's instructions, recommendations and material safety data sheets. Protect from damage from sunlight, weather, excessive temperatures and construction operations. Remove damaged material from the site and dispose of in accordance with applicable regulations.

B. Do not double-stack pallets of sheet-applied membrane components on the job site. Provide cover on top and all sides, allowing for adequate ventilation.

C. Protect sheet-applied membrane components from freezing and extreme heat.

D. Sequence deliveries to avoid delays, but minimize on-site storage.

1.09 PROJECT/SITE CONDITIONS

A. Environmental Limitations: Apply air barrier within the range of ambient and substrate temperatures recommended by air barrier manufacturer. Protect substrates from environmental conditions that affect performance of air barrier. Do not apply air barrier to a wet substrate or during snow, rain, fog or mist.

1.10 WARRANTY

A. Submit manufacturer's warranty that air barrier and accessories are free of defects at time of delivery and are manufactured to meet manufacturer's published physical properties and material specifications.

B. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Sheet-Applied Air Barrier Membrane (choose one):
   1. General Requirements:
      a. Membrane Air Permeance: ASTM E2178: Not to exceed 0.004 cfm/sq. ft. under a pressure differential of 0.3 in. water (1.57 psf) (equal to 0.02 L/s. x sq. m. @ 75 Pa).
      b. Assembly Air Permeance: Provide a continuous air barrier assembly that has an air leakage not to exceed 0.04 cfm/sq. ft. under a pressure differential of 0.3 in. water (1.57 psf) (equal to 0.2 L/s. x sq. m. @ 75 Pa).
      c. Water Resistance: ASTM E331: Pass.
      d. Water Vapor Permeance: ASTM E96, Method A: < 1 perm.
      e. Water Vapor Permeance: ASTM E96, Method B: < 1 perm.
      f. Elongation: ASTM D412-Die C: Minimum 200%.
      g. Low temperature flexibility and crack bridging: ASTM C1305: Pass.
      h. Fire Resistance: Evaluated for NFPA 285 as part of various wall assemblies.
   2. Perm-A-Barrier® NPS as manufactured by GCP Applied Technologies.
      a. 0.012 inch adhesive, 0.004 inch HDPE/AL, sheet applied, vapor impermeable membrane that forms a resilient, monolithic, fully bonded elastomeric membrane when applied to construction surfaces.
   3. CCW-705 LT as manufactured by Carlisle Coatings & Waterproofing Inc.
      a. 0.040 inch (40 mils) thickness membrane consisting of smooth surfaced, cross-laminated high density polyethylene (HDPE) film fully-coated with rubberized asphalt adhesive.
   4. ExoAir 110AT as manufactured by Tremco, Inc.
      a. Composite membrane, with not less that 16 mils of butyl laminated to not less than 6 mils metalized high-density polyethylene film.

B. Transition Membrane:
   1. General Requirements:
      a. Water Vapor Transmission: ASTM E96, Method B: 0.05 perms (2.9 ng/Pa s. sq. m.) maximum.
      b. Air Permeance at 75 Pa (0.3 in. water) pressure difference: 0.0006 L/s sq. m (0.00012 cfm/sq. ft.) maximum.
      c. Puncture Resistance: ASTM E154: 178 N (40 lbs) minimum.
      d. Lap Adhesion at minus 4 degrees C (25 degrees F): ASTM D1876: 880 N/m (5.0 lbs./in.) of width.
      e. Low Temperature Flexibility: ASTM D1970: Unaffected to minus 43 degrees C (minus 45 degrees F).

f. Tensile Strength: ASTM D412, Die C Modified: Minimum 2.7 MPa (400 psi).
g. Elongation, Ultimate Failure of Rubberized Aspahlt: ASTM D412, Die C: Minimum 200%.

2. Perm-A-Barrier Detail Membrane as manufactured by GCP Applied Technologies.
   a. 36 mils of self-adhesive rubberized asphalt integrally bonded to 4 mil cross-laminated, high-density polyethylene film to provide a minimum 40 mil thick membrane.
3. CCW-705 LT Air & Vapor Barrier Strips as manufactured by Carlisle Coatings & Waterproofing Inc.
   a. 0.040 inch (40 mils) thickness membrane consisting of smooth surfaced, cross-laminated high density polyethylene (HDPE) film fully-coated with rubberized asphalt adhesive.
4. ExoAir TWF Thru-Wall Flashing as manufactured by Tremco Inc.
   a. 40 mils thick self-adhering composite sheet consisting of 32 mils of SBS rubberized asphalt laminated to an 8 mil high-density, cross-laminated polyethylene film.

C. Flexible Membrane Thru-Wall Flashing:
1. General Requirements:
   a. Water Vapor Transmission: ASTM E96, Method B: 0.05 perms (2.9 ng/Pa s. sq. m.) maximum.
   b. Water Absorption: ASTM D570: Maximum 0.1% by weight.
   c. Puncture Resistance: ASTM E154: 336 N (80 lbs) minimum.
   d. Tear Resistance:
      1) Initiation, ASTM D1004: Minimum 58 N (13.0 lbs) M.D.
      2) Propagation, ASTM D1938: Minimum 40 N (9.0 lbs) M.D.
   e. Lap Adhesion at minus 4 degrees C (25 degrees F): ASTM D1876: 880 N/m (5.0 lbs./in.) of width.
   f. Low Temperature Flexibility: ASTM D1970: Unaffected to minus 43 degrees C (minus 45 degrees F).
   g. Tensile Strength: ASTM D412, Die C Modified: Minimum 5.5 MPa (800 psi).
   h. Elongation, Ultimate Failure of Rubberized Asphalt: ASTM D412, Die C: Minimum 200%.
2. Perm-A-Barrier Wall Flashing as manufactured by GCP Applied Technologies.
   a. 32 mils of self-adhesive rubberized asphalt integrally bonded to 8 mil of cross-laminated, high-density polyethylene film to provide a minimum 40 mil thick membrane.
3. CCW-705 LT Air & Vapor Barrier Strips as manufactured by Carlisle Coatings & Waterproofing Inc.
   a. 0.040 inch (40 mils) thickness membrane consisting of smooth surfaced, cross-laminated high density polyethylene (HDPE) film fully-coated with rubberized asphalt adhesive.
4. ExoAir TWF Thru-Wall Flashing as manufactured by Tremco Inc.

a. 40 mils thick self-adhering composite sheet consisting of 32 mils of SBS rubberized asphalt laminated to an 8 mil high-density, cross-laminated polyethylene film.

D. Primer: As recommended by manufacturer.

E. Penetration and Termination Sealant:
1. GCP Applied Technologies:
a. Liquid Membrane for Details and Terminations and Substrate Patching: Bituthene Liquid membrane; a two-part elastomeric, trowel grade material design for use with sheet-applied membrane, self-adhered membranes and tapes.
b. Sealant for Details, Final Terminations and Sheathing: Grace S100 Sealant; a one-part, neutral curing, ultra low modulus material designed for use with sheet-applied membranes, self-adhered membrane and tapes.
2. Carlisle Coatings & Waterproofing Inc.
a. Liquid Membrane for Details and Terminations and Substrate Patching: CCW-704; solvent-based, rubberized bitumen mastic.
b. Sealant for Details, Final Terminations and Sheathing: CCW-201; multi-component, chemical-curing, low-modulus, non-sag, polyurethane sealant.
3. Tremco Inc.
a. Liquid Membrane for Details and Terminations and Substrate Patching: ExoAir Termination Mastic; cold fluid-applied elastomeric liquid, trowel grade, with recommended glass-fiber-mesh tape.
b. Sealant for Details, Final Terminations and Sheathing: Dymonic 100; single-component polyurethane.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that substrates and conditions are ready to accept the Work of this Section. Notify Architect in writing of any discrepancies. Commencement of the Work or any parts thereof shall mean acceptance of the prepared substrates.

B. All surfaces must be sound, dry, clean and free of oil, grease, dirt, excess mortar or other contaminants detrimental to the adhesion of the membranes. Fill voids, gaps and spalled areas in substrate to provide an even plane. Strike masonry joints full-flush. Curing compounds or release agents used in concrete construction must be resin based without oil, wax or pigments.

3.02 PREPARATION

A. Refer to manufacturer’s literature for requirements for preparation of substrates. Surfaces shall be sound and free of voids, spalled areas, loose aggregate and sharp

protrusions. Remove contaminants such as grease, oil and wax from exposed surfaces. Remove dust, dirt, loose stone and debris. Use repair materials and methods that are acceptable to manufacturer of the sheet-applied air barrier assembly.

B. Exterior Sheathing Panels: Ensure that the boards are sufficiently stabilized with corners and edges fastened with appropriate screws.

C. Masonry Substrates: Apply air and vapor barrier over concrete block and brick with smooth trowel-cut mortar joints, struck full and flush. Fill all voids and holes, particularly in the mortar joints, with a lean mortar mix, non-shrinking grout and parge coat.

D. Related Materials: Treat construction joints and install flashing as recommended by manufacturer.

E. Clean, prepare, treat, and seal substrate according to manufacturer's written instructions. Provide clean, dust-free, and dry substrate for air barrier application.

F. Mask off adjoining surfaces not covered by air barrier to prevent spillage and overspray affecting other construction.

G. Remove grease, oil, bitumen, form-release agents, paint, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.

H. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids in concrete with substrate patching membrane.

I. Remove excess mortar from masonry ties, shelf angles, and other obstructions.

J. At changes in substrate plane, apply liquid membrane at sharp corners and edges to form a smooth transition from one plane to another.

K. Cover gaps in substrate plane and form a smooth transition from one substrate to another with a stainless steel sheet mechanically fastened to structural framing to provide continuous support for air barrier.

3.03 JOINT TREATMENT

A. Concrete and Masonry: Prepare, treat, rout, and fill joints and cracks in substrate according to ASTM C1193 and air barrier manufacturer's written instructions. Remove dust and dirt from joints and cracks complying with ASTM D4258 before coating surfaces.

3.04 AIR BARRIER MEMBRANE INSTALLATION

A. Apply air barrier membrane to achieve a continuous air barrier according to air barrier manufacturer's written instructions.

B. Apply air barrier membrane within manufacturer's recommended application temperature ranges.

C. Do not cover air barrier until it has been tested and inspected by Owner's testing agency.

D. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air barrier components.

3.05 PREFABRICATED WINDOW CORNER INSTALLATION

A. Install prefabricated window corners into rough openings of windows at bottom corners of the window openings prior to installing primer and transition membrane. Install the corners into the rough opening in accordance with manufacturer's installation instructions.

3.06 TRANSITION MEMBRANE INSTALLATION

A. Install strips, transition membrane, and auxiliary materials according to air barrier manufacturer's written instructions to form a seal with adjacent construction and maintain a continuous air barrier.

B. Apply primer to substrates to receive transition membrane at required rate ad allow to dry. Limit priming to areas that will be covered by transition tape in the same day. Re-prime areas exposed for more than 24 hours.
   1. Primer glass-fiber-surfaced gypsum sheathing with air membrane material with number of prime coats needed to achieve required bond, with adequate drying time between coats.

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.

D. At end of each working day, seal top edge of strips and transition membrane to substrate with termination sealant.

E. Apply joint sealants forming part of air barrier assembly within sealant manufacturer's recommended application temperature ranges. Consult sealant manufacturer when sealant cannot be applied within these temperature ranges.
   1. Wall Openings: Prime concealed perimeter frame surfaces of windows, curtain walls, storefronts, and doors. Apply transition membrane so that a minimum of 3 inches of coverage is achieved other both substrates. Roll firmly to enhance adhesion.

F. Fill gaps in perimeter frame surfaces of windows, curtain walls, storefronts, and doors, and miscellaneous penetrations of air barrier membrane with air barrier sealant.

G. Repair punctures, voids, and deficient lapped seams in strip and transition membrane. Silt and flatten fish-mouths and blisters. Patch with transition membrane extending 6 inches beyond repaired areas in strip direction.

3.07 FIELD QUALITY CONTROL

A. Testing Agency: Owner may engage a qualified testing agency to perform tests and inspections and prepare test reports.

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 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 if 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 membrane have complied with minimum requirements and have been shingled in the correct direction (or mastic has been applied on exposed edges), with no fish-mouths.
   8. Termination sealant has been applied on cut edges.
   9. Strips and transition membrane 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: Testing to be performed will be determined by Owner's testing agency from among the following tests:
   1. Qualitative Testing: Air barrier assemblies will be testing for evidence of air leakage according to ASTM E1186.

D. Remove and replace deficient air barrier components and retest as specified above.

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.

B. Protect air barrier from exposure to UV light and harmful weather exposure as required by manufacturer. Remove and replace main air barrier material exposed for more than 12 months.

C. 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.

D. Remove masking materials after installation.

END OF SECTION

SECTION 07 41 00

METAL ROOF PANELS
(THIS WORK IS TO BE INCLUDED AS PART OF SECTION 13 34 19)

PART 1 - GENERAL

1.01 SUMMARY

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 1 – GENERAL REQUIREMENTS, which are hereby made a part of this Section of the Specifications.

B. Section Includes:
   1. Steel Faced, polyisocyanurate metal roof panels.
   2. Accessories including fasteners and perimeter trim.

C. **Work in this Section is included as part of the work in Section 13 34 19**.

1.02 RELATED SECTIONS

A. Section 07 27 26, AIR BARRIER.

B. Section 07 42 00, METAL WALL PANELS.

C. Section 07 72 53, SNOW GUARDS.

D. Section 13 34 19, PRE-ENGINEERED BUILDING.

1.03 REFERENCES

A. ASTM International (ASTM):
   1. A653 – Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron-Alloy-Coated (Galvannealed) by the Hot-Dip Process.
   2. A755 – Standard Specification for Steel Sheet, Metallic Coated by the Hot-Dip Process and Pre-painted by the Coil-Coating Process for Exterior Exposed Building Products.
   3. A792 – Standard Specification for Steel Sheet, 55 percent Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.
   4. B117 – Standard Practice for Operating Salt Spray (Fog) Apparatus.
   5. C518 – Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
   6. D522 – Standard Test Methods for Mandrel Bend Test of Attached Organic Coatings.
   7. D523 – Standard Test Method for Specular Gloss.

8. D714 – Standard Test Method for Evaluating Degree of Blistering of Paints.
9. D968 – Standard Test Methods for Abrasion Resistance of Organic Coatings by Falling Abrasive.
10. D1308 – Standard Test Method for Effect of Household Chemicals on Clear and Pigmented Organic Finishes.
11. D2244 – Standard Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates.
12. D2247 – Standard Practice for Testing Water Resistance of Coatings in 100 percent Relative Humidity.
13. D2794 – Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact).
14. D3273 – Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber.
15. D3359 – Standard Test Methods for Measuring Adhesion by Tape Test.
16. D3363 – Standard Test Method for Film Hardness by Pencil Test.
17. D4145 – Standard Test Method for Coating Flexibility of Prepainted Sheet.
18. D4214 – Standard Test Methods for Evaluating the Degree of Chalking of Exterior Paint Films.
19. E72 – Standard Test Methods of Conducting Strength Tests of Panels for Building Construction.
20. E84 – Standard Test Method for Surface Burning Characteristics of Building Materials.
21. E283 – Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
22. E331 – Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference.
23. E1646 – Standard Test Method for Water Penetration of Exterior Metal Roof Panel Systems by Uniform Static Air Pressure Difference.
24. E1680 – Standard Test Method for Rate of Air Leakage Through Exterior Metal Roof Panel Systems.
25. G153 – Standard Practice for Operating Enclose Carbon Arc Light Apparatus for Exposure for Nonmetallic Materials.
26. G154 – Standard Practice for Operating Fluorescent Light Apparatus for UV Exposure for Nonmetallic Materials.

B. Underwriters Laboratories (UL):
   1. UL 580 – Test for Uplift Resistance of Roof Assemblies.

C. Factory Mutual (FM):
   1. FM 4471 – Approved Standard for Class 1 Panel Roofs.

1.04 SUBMITTALS

A. Submit in accordance with Section 01 33 00, SUBMITTALS.

B. Product Data: Submit manufacturer current technical literature for each type of product.

C. Shop Drawings: Submit detailed drawings and panel analysis showing:
   1. Profile.
   2. Gauge of both exterior and interior sheet.
   3. Location, layout and dimensions of panels.
   4. Location and type of fasteners.
   5. Shape and method of attachment of all trim.
   6. Locations and types of sealants.
   7. Other details as may be required for a weathertight installation.

D. Panel Analysis: Provide panel calculations to indicate compliance with maximum deflection of L/240 for the indicated design loads. Include effects of thermal differential between the exterior and interior panel facings.

E. Samples: Provide panel width by 8 inches long.

F. Miscellaneous Certifications:
   1. Submit documentation that products have been certified in accordance with ISO 14025.

G. Quality Assurance Submittals:
   1. Design Data, Test Reports: Provide manufacturer test reports indicating product compliance with requirements.
   2. Manufacturer Erection Instructions: Provide manufacturer's written installation instructions including proper material storage, material handling, installation sequence, panel location(s), and attachment methods, details and required trim and accessories.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications:
   1. Manufacturer shall have a minimum of five (5) years experience in the production of insulated wall panels. Manufacturer shall demonstrate past experience with examples of projects of similar type and exposure.
   2. Manufacturer to be registered with a Program Operator with a Certified, Environmental Product Declaration, in conformance with ISO 14025, for Insulated Metal Panels.

B. Installer Qualifications:
   1. Authorized by the manufacturer and the work shall be supervised by a person having a minimum of five (5) years experience installing insulated wall panels on similar type and size projects.

2. Installation shall be in accordance with manufacturer's installation guidelines and recommendations.

C. Wind and Uplift Rating:
   1. Design Uplift Load: As required by 780 CMR, 9th edition.
   2. Units shall be rated and carry the following listings:
      a. Factory Mutual 1-105 uplift rating for 5 foot spans with minimum 14 gauge purlins.
      b. Factory Mutual 4771 – Class 1 Approval.
      c. UL 580, Class 90 uplift ratings for 5 foot spans with a minimum 14 gauge purlins.
      d. UL 580, Class 90 uplift rating for panels attached to 20 gauge decking with fastening, 3 foot on center.

1.06 DELIVERY, STORAGE AND HANDLING

A. Deliver panel materials and components in manufacturer's original, unopened, undamaged packaging with identification labels intact.

B. Store roofing panel materials on dry, level, firm, and clean surface using the three inch factory provided foam supports under the panels. Use of wood substitute is not acceptable. Stack no more than two bundles high. Elevate and ventilate to allow aor to circulate and moisture to escape.

1.07 WARRANTY

A. Limited Warranty: Standard form in which manufacturer agrees to repair or replace items that fail in materials or workmanship within specified warranty period. The items covered by the warranty include bond integrity, deflection and buckling.
   1. Warranty Period: Two (2) years from date of Substantial Completion.

B. Finish Warranty: Standard form in which manufacturer agrees to repair or replace metal panels that evidence deterioration of fluoropolymer finish, including flaking or peeling from approved primed metal substrate, chalk in excess of 8 when tested in accordance with ASTM D4214, Method A, and/or color fading in excess of 5 ΔE Hunter units on panels when tested in accordance with ASTM D2244.
   1. Warranty Period: Twenty (20) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Metl-Span, a Division of NCI Group Inc., Lewisville, TX.

B. Kingspan Insulated Panels, Inc., 726 Summerhill Drive, Deland, FL 32724.

C. MBCI Metal Roof and Wall Systems, Division of NCI Group, Inc., Houston, TX.

2.02 STANDING SEAM ROOF PANELS

A. Panel Description:
   1. Basis of Design Panel: CFR Insulated Metal Panel as manufactured by Metl-Span.
   2. Panel Thickness: 6 inches.
   3. Panel Width: 42 inches.
   4. Panel Length: As indicated on Drawings.
   5. The side joint shall consist of a 2 inch vertical sidelap, mechanically seamed, with fasteners and thermally broken attachment clip completely concealed within the side joint.
   6. Exterior Face Panel:
      a. Material: AZ50 Galvalume per ASTM A792.
      b. Profile: Shallow “minor rib”.
      c. Texture: Stucco embossed.
      d. Gauge: 22 gauge.
      e. Yield: 33 ksi minimum.
      f. Exterior Finish: Valspar Fluropon PVDF finish, dry film thickness of 1.0 mil including primer.
      g. Color: “Pewter”.
   7. Interior Face Panel:
      a. Material: AZ50 Galvalume per ASTM A792.
      b. Profile: Shallow “minor rib”.
      c. Texture: Stucco embossed.
      d. Gauge: 24 gauge.
      e. Yield: 33 ksi minimum.
      f. Exterior Finish: Valspar Dynapon modified polyester finish with a total minimum dry film thickness of 1.0 mil including primer.
      g. Color: “Regal Gray”.
   8. Insulating Core: Minimum 95 percent closed cell structure urethane modified isocyanurate core with the following minimum physical properties:
      a. Density Nominal: 2.4 pcf.
      b. Shear Strength: 25 psi (to side).
      c. Tensile Strength: 23 psi.
      d. Compressive Strength: 14-22 psi.
      e. Surface Burning Characteristics when tested in accordance with ASTM E84:
         1) Flame Spread: Less than 25.
         2) Smoke Developed: Less than 450.

B. Physical Characteristics:
   1. Structural Test: Design shall be verified by representative structural test for wind loads in accordance with ASTM E72. The deflection criteria shall be L/240.
   2. Thermal Properties: The panel shall provide a nominal R-value of 7.2 hr ft² °F/Btu per inch thickness when tested in accordance with ASTM C518 at 75°F mean temperature and 8.0 nominal R-value of 7.2 hr ft² °F/Btu per inch thickness when tested in accordance with ASTM C518 at 35°F mean temperature.
   3. Fatigue Test: There shall be no evidence of metal/insulation interface delamination when the panel is tested by simulated wind loads of 20 psf (positive and negative loads), when applied for two million alternate cycles.
   4. Bond Strength: No metal primer interface corrosion and/or delamination shall occur after 1,000 hours at 140 degrees F and 100 percent relative humidity. No delamination shall occur after 2-1/2 hours in a 2 psi 212 degrees F autoclave.
   5. Water Penetration: There shall be no uncontrolled water leakage at pressures of up to 20 psf when tested in accordance with ASTM E331 and ASTM E1646. Tested assembly must include endlap and sidelap conditions.
   6. Air Infiltration: Air infiltration through the roof shall not exceed 0.003 cfm/sf at 6.24 psf air pressure differential when tested in accordance with ASTM E283 and ASTM E1680. Tested assembly must include endlap and sidelap conditions.
   7. Hailstorm Rating: Factory Mutual 1 SH hailstorm rating.

C. Paint Finish Characteristics:
   1. Gloss: 15 ±5 measured at 60 degrees angle tested in accordance with ASTM D523.
   2. Pencil Hardness: HB-H minimum tested in accordance with ASTM D3363.
   3. Flexibility, T-Bend: 1-2T bend with no adhesion loss when tested in accordance with ASTM D4145.
   4. Flexibility, Mandrel: No cracking when bent 180 degrees around a 1/8 mandrel as tested in accordance with ASTM D522.
   5. Adhesion: No adhesion loss tested in accordance with ASTM D3359.
   6. Reverse Impact: No cracking or adhesion loss when impacted 3000 by inches of metal thickness (lb-in), tested in accordance with ASTM D2794.
   7. Abrasion Resistance: Nominal 65 liters of falling sand to expose 5/32 inch diameter of metal substrate when tested in accordance with ASTM D968.
   8. Graffiti Resistance: Minimal effect.
   9. Acid Pollutant Resistance: No effect when subjected to 30 percent sulfuric acid for 18 hours, or 10 percent muriatic acid for 15 minutes when tested in accordance with ASTM D1308.
   10. Salt Fog Resistance: Passes 1,000 hours, when tested in accordance with ASTM B117 (5 percent salt fog at 95°F).
   11. Cyclic Salt Fog and UV Exposure: Passes 2,016 hours when tested in accordance with ASTM D5894.
   12. Humidity Resistance: Passes 1,500 hours at 100 percent relative humidity and 95°F, with a test rating of 10 when tested in accordance with ASTM D2247, and D714.

13. Color Retention: Passes 5,000 hours when tested in accordance with ASTM G153 and G154.
14. Chalk Resistance: Maximum chalk is a rating of 8 when tested in accordance with ASTM D4214, Method A.
15. Color Tolerances: Maximum of 5ΔE Hunter units on panels when tested in accordance with ASTM D2244.

2.03 ACCESSORIES

A. Fasteners:
   1. Self-drilling fasteners shall be corrosion resistant plated steel, designed to resist maximum negative pulloff loads and hold the face sheet mechanically to the structural support.
   2. Panel attachment clip shall be two pieces and fully concealed within the panel sidejoint. Base clip shall be a minimum 14 gauge galvanized, and top clip shall be a minimum 20 gauge stainless steel with an integral thermal break.
   3. Vibration resistant type (anti-backout threads) fasteners. Self-drilling flathead screws with sealing washers and square drives, designed to resist back out by increasing thread friction as screw loosens.

B. Perimeter Trim:
   1. Fabricated perimeter trim and metal flashing: Shall be same gauge, material and coating color as exterior face of insulated metal panels.

C. Sealants: Butyl, non-skinning/curing type as recommended by manufacturer.

D. Butyl Tape: Per manufacturer's recommendations for panel to panel and panel to trim seal.

E. Downspout Adapter: 9P10 by NDS or approved equal.
   1. PVC Type I material.
   2. PVC: ASTM D3034 and D2729.
   3. Styrene: ASTM D2852.

F. Pipe Flashing: MasterFlash EPDM by Aztec Washer Co., or approved equal.

G. Metal Roof Curb: Prefabricated metal roof curb by LMCurbs, or approved equal.
   1. Constructed using minimum .080, 300H14 aluminum, or heavier as required to support the load of the equipment, with fully mitered and heli-arc welded corners, integral base plates, with water diverter cricket.
   2. Minimum height of curb shall be 8" above finished roof.
   3. Curbs shall be constructed to match slope of roof and provide a level top surface for mounting of equipment.

4. Curb flange shall be constructed to match configuration of roof panel. Side flange shall extend to the next natural seam in the roof panels and conform to seam configurations.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine alignment of the structure and supports prior to installing the insulated metal roof panels.
   1. Structure Tolerance: In the plane of the roof 0 inches inward, plus ½ inch outward.
   2. All deviations from structural tolerances shall be corrected by the responsible party prior to installation of the panels.

B. Examine individual panels upon removing from the bundle; both edges should be visually examined and any slight overfill of insulation should be carefully removed.

3.02 PANEL INSTALLATION

A. Remove protective film before installation, or immediately thereafter to prevent sunlight damage.

B. Cut panels, where indicated on shop drawings, using a power circular saw with fine tooth carbide tip blades or a band saw prior to installation. Ventilate area where polyurethane dust is generated. Personnel should wear respiratory and eye protection devices.

C. Apply butyl sealant vapor seal around interior perimeter of roof assembly per panel manufacturer's instructions.

D. Apply butyl tape on panel sidelaps and clip assemblies per panel manufacturer's instructions.

E. Secure units to the steel supports with manufacturer's recommened fastener.

F. Place panel fasteners through predrilled top clip and base clip, concealed within the side joint of the panel.
   1. Head of concealed fasteners shall be insulated from the exterior environment to prevent condensation and "ice balling" from occurring on the fastener shaft.

G. Apply endlap sealing tape and butyl to panel surface to be lapped per manufacturer's instructions.

H. Endlap panel stitch fasteners to be vibration resistant type.

I. As each panel is installed, crimp hidden clip assembly prior to placement of next panel.

J. Repair or replace metal panels and trim that have been damaged.

3.03 TRIM INSTALLATION

A. Place trim to determine the location of the closure strips, sealant and ridge closure trims.

B. Apply butyl tape above and below the foam closure strip and seat the closure strip firmly in the tape to ensure a continuous seal. If any voids exist add butyl caulking and reseat the closure.

C. Place a continuous layer of butyl tape on top of the metal ridge closure trims for the length of the building.

D. Fasten the exterior ridge trim to the metal ridge closure trims, per manufacturer's recommendations, on center with ¼ inch by 7/8 inch low profile vibration resistant stitch fasteners.

END OF SECTION

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SECTION 07 42 00

METAL WALL PANELS
(THIS WORK IS TO BE INCLUDED AS PART OF SECTION 13 34 19)

PART 1 - GENERAL

1.01 SUMMARY

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 1 – GENERAL REQUIREMENTS, which are hereby made a part of this Section of the Specifications.

B. Section Includes:
   1. Steel Faced, polyisocyanurate metal wall panels.
   2. Accessories including fasteners and perimeter trim.

C. **Work in this Section is included as part of the work in Section 13 34 19**.

1.02 RELATED SECTIONS

A. Section 04 20 01, UNIT MASONRY.

B. Section 07 27 26, AIR BARRIER.

C. Section 07 41 00, METAL ROOF PANELS.

D. Section 07 60 00, FLASHING AND SHEET METAL.

E. Section 07 90 00, SEALANTS AND CAULKING.

F. Section 13 34 19, PRE-ENGINEERED BUILDING.

1.03 REFERENCES

A. American Architectural Manufacturers Association (AAMA):
   1. 501.2 – Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls and Sloped Glazing Systems.

B. American Society of Civil Engineers (ASCE):
   1. ASCE 7 – Minimum Design Loads for Buildings and Other Structures.

C. ASTM International (ASTM):
   1. A480 – Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip.

2. A653 – Standard Specification for Steel Sheet, Zinc-Coated (Glavanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
3. A755 – Standard Specification for Steel Sheet, Metallic Coated by the Hot-Dip Process and Prepainted by the Coil-Coating Process for Exterior Exposed Building Products.
4. A792 – Standard Specification for Steel Sheet, 55 percent Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.
5. A924 – Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
6. B117 – Standard Practice for Operating Salt Spray (Fog) Apparatus.
7. C723 – Standard Test Method for Shear Properties of Sandwich Core Materials.
8. C518 – Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
9. D522 – Standard Test Methods for Mandrel Bend Test of Attached Organic Coatings.
10. D523 – Standard Test Method for Specular Gloss.
11. D714 – Standard Test Method for Evaluating Degree of Blistering of Paints.
12. D968 – Standard Test Methods for Abrasion Resistance of Organic Coatings by Falling Abrasive.
13. D1308 – Standard Test Method for Effect of Household Chemicals on Clear and Pigmented Organic Finishes.
14. D1621 – Standard Test Method for Compressive Properties of Rigid Cellular Plastics.
15. D1622 – Standard Test Method for Apparent Density of Rigid Cellular Plastics.
16. D1623 – Standard Test Method for Tensile and Tensile Adhesion Properties of Rigid Cellular Plastics.
17. D1654 – Standard Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments.
18. D1929 – Standard Test Method for Determining Ignition Temperature of Plastics.
19. D2126 – Standard Test Method for Response of Rigid Cellular Plastics to Thermal and Humid Aging.
20. D2244 – Standard Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates.
21. D2247 – Standard Practice for Testing Water Resistance of Coatings in 100 percent Relative Humidity.
22. D2794 – Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact).
23. D3273 – Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber.
24. D3359 – Standard Test Methods for Measuring Adhesion by Tape Test.
25. D3363 – Standard Test Method for Film Hardness by Pencil Test.
26. D4145 – Standard Test Method for Coating Flexibility of Prepainted Sheet.
27. D4214 – Standard Test Methods for Evaluating the Degree of Chalking of Exterior Paint Films.
28. D5894 – Standard Practice for Cyclic Salt Fog/UV Exposure of Painted Metal, (Alternating Exposures in a Fog/Dry Cabinet and a UV Condensation Cabinet).

29. D6226 – Standard Test Method for Open Cell Content of Rigid Cellular Plastics.
30. E72 – Standard Test Methods of Conducting Strength Tests of Panels for Building Construction.
31. E84 – Standard Test Method for Surface Burning Characteristics of Building Materials.
32. E90 – Standard Testing Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
33. E283 – Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
34. E331 – Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference.
35. E413 – Classification of Rating Sound Insulation.
36. G153 – Standard Practice for Operating Enclose Carbon Arc Light Apparatus for Exposure for Nonmetallic Materials.
37. G154 – Standard Practice for Operating Fluorescent Light Apparatus for UV Exposure for Nonmetallic Materials.

D. FM Global (FM):
   1. Approved Standard 4880; Class 1 Fire Rating of Insulated Wall or Wall and Roof/Ceiling Panels, Interior Finish Materials or Coatings, and Exterior Wall Systems.
   2. Approved Standard 4881; Class 1 Exterior Wall Systems.

E. National Fire Protection Agency (NFPA):
   1. 259 – Standard Test Method for Potential Heat of Building Materials.
   2. 285 – Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components.

F. UL Canada (ULC) Approvals:
   1. S101 – Standard Methods for Fire Endurance Tests of Building Construction and Materials.
   2. S102 – Standard Method of Test for Surface Building Characteristics of Building Materials and Assemblies.
   3. S127 – Standard Corner Wall Method of Test for Flammability Characteristics of Non-Melting Building Materials.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Pre-installation Meeting: Conduct a pre-installation meeting at the job site attended by Owner, Architect, Contractor, Manufacturer’s Technical Representative, Panel Installer, and Contractors of related trades. Coordinate structural support requirements in relation to insulated wall panel system, installation of any separate air/water barriers, treatment of fenestration, and other requirements specific to the Project.

1.05 SUBMITTALS

A. Submit in accordance with Section 01 33 00, SUBMITTALS.

B. Product Data: Submit manufacturer current technical literature for each type of product.
C. Shop Drawings: Submit detailed drawings and panel analysis showing:
   1. Profile.
   2. Gauge of both exterior and interior sheet.
   3. Location, layout and dimensions of panels.
   4. Location and type of fasteners.
   5. Shape and method of attachment of all trim.
   6. Locations and types of sealants.
   7. Installation sequence.
   8. Coordination Drawings: Provide elevation drawings and building sections which show panels in relationship to required locations for structural support. Include panel details and details showing attachment to structural support.
   9. Other details as may be required for a weathertight installation.

D. Panel Analysis: Provide panel calculations to verify panels will withstand the design wind loads indicated without detrimental effects or deflection exceeding L/180. Include effects of thermal differential between the exterior and interior panel facings and resistance to fastener pullout.

E. Samples: Provide panel width by 8 inches long.

F. Miscellaneous Certifications:
   1. Submit documentation that products have been certified in accordance with ISO 14025.

G. Quality Assurance Submittals:
   1. Design Data, Test Reports: Provide manufacturer test reports indicating product compliance with requirements.
   2. Manufacturer Erection Instructions: Provide manufacturer’s written installation instructions including proper material storage, material handling, installation sequence, panel location(s), and attachment methods, details and required trim and accessories.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications:
   1. Manufacturer shall have a minimum of five (5) years experience in the production of insulated wall panels. Manufacturer shall demonstrate past experience with examples of projects of similar type and exposure.

2. Manufacturer to be registered with a Program Operator with a Certified, Environmental Product Declaration, in conformance with ISO 14025, for Insulated Metal Panels.

B. Installer Qualifications: Authorized by the manufacturer and the work shall be supervised by a person having a minimum of five (5) years experience installing insulated wall panels on similar type and size projects.

1.07 DELIVERY, STORAGE AND HANDLING

A. Deliver panel materials and components in manufacturer's original, unopened, undamaged packaging with identification labels intact.

B. Store wall panel materials on dry, level, firm, and clean surface. Stack no more than two bundles high. Elevate one end of bundle to allow moisture run-off, cover and ventilate to allow air to circulate and moisture to escape.

1.08 WARRANTY

A. Limited Warranty: Standard form in which manufacturer agrees to repair or replace items that fail in materials or workmanship within specified warranty period. The items covered by the warranty include bond integrity, deflection and buckling.
1. Warranty Period: Two (2) years from date of Substantial Completion.

B. Finish Warranty: Standard form in which manufacturer agrees to repair or replace metal panels that evidence deterioration of fluoropolymer finish, including flaking or peeling from approved primed metal substrate, chalk in excess of 8 when tested in accordance with ASTM D4214, Method A, and/or color fading in excess of 5 ΔE Hunter units on panels when tested in accordance with ASTM D2244.
1. Warranty Period: Twenty (20) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Metl-Span, a Division of NCI Group Inc., Lewisville, TX.

B. Kingspan Insulated Panels, Inc., 726 Summerhill Drive, Deland, FL 32724.

C. MBCI Metal Roof and Wall Systems, Division of NCI Group, Inc., Houston, TX.

2.02 INSULATED METAL PANELS

A. Design Criteria:
   1. Wind Loads: In accordance with 780 CMR, 9th edition.
   2. Deflection Criteria: L/360.

B. Performance Criteria:
   1. Structural Test: Structural performance shall be verifiable by witnessed structural testing for simulated wind loads in accordance with ASTM E72.
   2. Thermal Properties: The panel shall provide a nominal R-value of 7.2 hr ft² °F/Btu per inch thickness when tested in accordance with ASTM C518 at 75°F mean temperature and 8.0 hr ft² °F/Btu per inch thickness when tested in accordance with ASTM C517 at 35°F mean temperature.
   3. Fatigue Test: There shall be no evidence of metal/insulation interface delamination when the panel is tested by simulated wind loads (positive and negative loads), when applied for two million alternate cycles of L/180 deflection.
   4. Water Penetration: There shall be no uncontrolled water penetration through the panel joints at a pressure differential of 20 psf, when tested in accordance with ASTM E331.
   5. Air Infiltration: Air infiltration through the panel shall not exceed 0.001 cfm/sf at 20 psf air pressure differential when tested in accordance with ASTM E283.
   6. Panels shall have a minimum sound transmission coefficient (STC) of 22 when tested in accordance with ASTM E90 and rated in accordance with ASTM E413.
   7. Humidity Test: Panels shall exhibit no delamination or metal interface corrosion when subjected to 140°F temperature and 100 percent relative humidity for a total of 1,500 hours.
   8. Seismic Performance: Comply with ASCE 7, Section 13, “Seismic Design Requirements for Non-Structural Components.” Panels shall be hard-fastened to structure along one edge only such that lateral slippage between panels can occur in the event of seismic activity.
   9. Fire Test Response Characteristics: Steel-faced panels with polyisocyanurate (ISO) core shall fully comply with Chapter 26 of 780 CMR, 9th edition regarding the use of Foam Plastic.
      a. FM 4880: Class I rated per FM Global, panels are approved for use without a thermal barrier and do not create a requirement for automatic sprinkler protection.
      b. NFPA 285 Intermediate Scale Multi-story Fire Evaluation; successfully passed acceptance criteria.
      c. UL 263 Fire Resistive Rating; classified as a component of a fire-rated wall assembly for 1-hour and 2-hour rating Design No. U053 (rated assemblies include appropriate layers of fire-rated Type X Gypsum board).
      d. ASTM D1929 Minimum Flash and Self Ignition; established for foam core.
      e. NFPA 259 Potential Heat Content; established for foam core.
      f. S101, S102, S127 UL Canada fire test standards; successfully passed.
   10. Windborne Debris Rating for Wall Panel:

a. Meets requirements for high velocity hurricane zone with large missile impact when tested in accordance with FM Standard 4881.

11. Insulating Core: Polyisocyanurate (ISO) core, ASTM C591 Type IV, CFC and HCFC free, compliant with Montreal Protocol and Clean Air Act, with the following minimum physical properties:
    a. Core is minimum 91 percent closed cell when tested in accordance with ASTM D6226.
    b. Foam has density of 2.3 to 2.6 pounds per cubic foot when tested in accordance with ASTM D1622.
    c. Compressive Stress when tested in accordance with ASTM D1621:
        1) Parallel to Rise: Minimum of 19 psi.
        2) Perpendicular to Rise: 23 psi.
    d. Shear Stress: Minimum of 25 psi when tested in accordance with ASTM C273.
    e. Tensile Stress: Minimum of 23 psi when tested in accordance with ASTM D1623.
    f. Dimensional Stability when tested in accordance with ASTM D2126:
        1) High Temperature Aging at 158°F and plus 100 percent relative humidity for 14 days; less than 6 percent volume change.
        2) High Temperature Aging at 212°F and ambient humidity for 14 days; less than 4 percent volume change.
        3) Low Temperature Aging at -40°F and ambient humidity at 14 days; one percent volume change.
12. Flame Spread and Smoke Developed Tests on exposed Insulating Core when tested in accordance with ASTM E84:
    a. Flame Spread: Less than 25.
    b. Smoke Developed: Less than 450.

C. Paint Finish Characteristics:
1. Gloss: 15 ±5 measured at 60 degrees angle tested in accordance with ASTM D523.
2. Pencil Hardness: HB-H minimum tested in accordance with ASTM D3363.
3. Flexibility, T-Bend: 1-2T bend with no adhesion loss when tested in accordance with ASTM D4145.
4. Flexibility, Mandrel: No cracking when bent 180 degrees around a 1/8 mandrel as tested in accordance with ASTM D522.
5. Adhesion: No adhesion loss tested in accordance with ASTM D3359.
6. Reverse Impact: No cracking or adhesion loss when impacted 3000 by inches of metal thickness (lb-in), tested in accordance with ASTM D2794.
7. Abrasion Resistance: Nominal 65 liters of falling sand to expose 5/32 inch diameter of metal substrate when tested in accordance with ASTM D968.
8. Graffiti Resistance: Minimal effect.
9. Acid Pollutant Resistance: No effect when subjected to 30 percent sulfuric acid for 18 hours, or 10 percent muriatic acid for 15 minutes when tested in accordance with ASTM D1308.

10. Salt Fog Resistance: Passes 1,000 hours, when tested in accordance with ASTM B117 (5 percent salt fog at 95°F).
11. Cyclic Salt Fog and UV Exposure: Passes 2,016 hours when tested in accordance with ASTM D5894.
12. Humidity Resistance: Passes 1,500 hours at 100 percent relative humidity and 95°F, with a test rating of 10 when tested in accordance with ASTM D2247, and D714.
13. Color Retention: Passes 5,000 hours when tested in accordance with ASTM G153 and G154.
14. Chalk Resistance: Maximum chalk is a rating of 8 when tested in accordance with ASTM D4214, Method A.
15. Color Tolerances: Maximum of 5ΔE Hunter units on panels when tested in accordance with ASTM D2244.

D. Panel Assembly:
1. Basis of Design Product: CF Flute Wall Panel as manufactured by Metl-Span.
2. Panel Thickness: 4 inches.
3. Panel Width: 42 inches.
4. Panel Lengths: As indicated on Drawings.
5. Panel Attachment: Consisting of fasteners and steel attachment clip completely concealed within the panel side joint.
6. Exterior Face Panel:
   a. Material:
      1) Steel coil material shall be in accordance with ASTM A755: AZ50 Galvalume®/Zincalume® (55 percent aluminum, 45 percent zinc) in accordance with ASTM A792.
      2) Gauge: 24 gauge.
   b. Profile: Minor rib.
   c. Texture: Non-directional stucco embossed.
   d. Exterior Paint Finish Color:
      1) Color: “Natural Patina”.
      2) Finish System: 1.0 mil Fluropolymer (PVDF) Two Coat system; 0.2 mil primer with 0.8 mil Kynar 500 (70 percent) solid color coat.
7. Interior Face Panel:
   a. Material:
      1) Steel coil material shall be in accordance with ASTM A755: AZ50 Galvalume®/Zincalume® (55 percent aluminum, 45 percent zinc) in accordance with ASTM A792.
      2) Gauge: 26 gauge
   b. Profile: Minor rib.
   c. Texture: Non-directional stucco embossed.
   d. Interior Finish:
      1) Color: Regal Gray.
      2) Modified polyester, dry film thickness of 1.0 mil including primer.

2.03 ACCESSORIES

A. Fasteners:
   1. Self-drilling fasteners shall be corrosion resistant plated steel with neoprene washer, as recommended by manufacturer.
   2. Material: Hex-head type with steel and neoprene washer and 12 gauge stainless steel clip supplied by the manufacturer.
   3. Size: As recommended by manufacturer.

B. Perimeter Trim:
   1. Fabricated perimeter trim and metal flashing: Shall be same gauge, material and coating color as exterior face of insulated metal panels.

C. Sealants: Butyl, non-skinning/curing type as recommended by manufacturer.

D. Butyl Tape: As recommended by manufacturer.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Provide field measurements to manufacturer as required to achieve proper fit of the preformed wall panel envelope. Measurements shall be provided in a timely manner so that there is no impact to construction or manufacturing schedule.

B. Supporting Steel: All structural supports required for installation of panels shall be by others. Support members shall be installed within the following tolerances:
   1. Plus or minus 1/8 inch in 5 feet in any direction along plane of framing.
   2. Plus or minus 3/8 inch cumulative in 20 feet in any direction along plane of framing.
   3. Plus or minus ¾ inch from framing plane on any elevation.
   4. Verify that bearing support has been provided behind horizontal joints of vertical panel systems and behind vertical joints of horizontal panel systems. Width of support shall be as recommended by manufacturer.

C. Examine individual panels upon removing from the bundle; notify manufacturer of panel defects. Do not install defective panels.

3.02 PANEL INSTALLATION

A. Installation shall be in accordance with manufacturer’s installation guidelines and recommendations.

B. Install panels plumb, level, and true-to-line to dimensions and layout indicated on approved shop drawings.

C. Cut panels prior to installing, where indicated on shop drawings, using a power circular saw with fine tooth carbide tip blade per manufacturer's instructions. Personnel should wear respiratory and eye protection devices.

D. Butyl Weather Barrier Sealant:
   1. Apply non-skinning butyl sealant as shown on shop drawings and manufacturer's installation instructions as necessary to establish the vapor barrier for the panels.
   2. Use non-skinning butyl tube sealant only for tight metal-to-metal contact.
   3. Do not use non-skinning butyl tube sealant to bridge gaps.

E. Place panel fasteners through pre-punched holes in attachment clips, concealed within the joint of the panel. Secure units to the structural supports. Space clips as recommended by manufacturer or otherwise indicated on the approved shop drawings.

3.03 TRIM INSTALLATION

A. Place trim and trim fasteners only as indicated per details on the approved shop drawings.

B. Field drill weep holes where appropriate in horizontal trim; minimum ¼ inch diameter at 24 inches on center.

C. Place a continuous strip of butyl tube sealant between the inside back face of closure trims and interior faces for proper weather seal.

3.04 SEALANT INSTALLATION FOR EXPOSED JOINTS

A. Clean and prime surfaces to receive exterior exposed sealants in accordance with sealant manufacturer's recommendations.

B. Follow sealant manufacturer's recommendations for joint width-to-depth ratio, application temperature range, size and type of backer rod, and compatibility of materials for adhesion.

C. Direct contact between butyl and silicone sealants shall not be permitted.

3.05 FIELD QUALITY CONTROL

A. Testing Agency: Contractor shall engage an independent testing and inspection agency acceptable to the Architect to perform field tests and inspections and prepare reports of findings.

B. Field Water Test: After completing portion of insulated metal panels including accessories and trim, test a 2-bay area selected by the Architect for water penetration in accordance with AAMA 501.2.

3.06 CLEANING AND PROTECTION

A. Remove protective film immediately after installation.

B. Touch-up, repair or replace metal panels and trim that have been damaged.

C. After metal panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.

END OF SECTION

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SECTION 07 60 00

FLASHING AND SHEET METAL

PART 1 - GENERAL

1.01 SUMMARY

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 1 – GENERAL REQUIREMENTS, which are hereby made a part of this Section of the Specifications.

B. Section Includes: Furnish and install specified metal flashing required to complete the wall and fenestration application according to details as specified herein. This includes but is not limited to the following:
   1. Sheet metal flashings at perimeters, walls, base flashing and counter-flashings.

1.02 RELATED SECTIONS

A. Section 04 20 01, UNIT MASONRY.

B. Section 06 10 00, ROUGH CARPENTRY.

C. Section 07 42 00, METAL WALL PANELS.

D. Section 08 54 13, FIBERGLASS WINDOWS.

1.03 REFERENCES

A. Aluminum Association (AA):
   1. AA-C22A41 – Aluminum Chemically Etched Medium Matte, With Clear Anodic Coating, Class I Architectural, 0.7 mil Thick.
   2. AA-C22A42 – Chemically Etched Medium Matte, With Integrally Colored Anodic Coating, Class I Architectural, 0.7 mil Thick.
   3. AA-C22A44 – Chemically Etched Medium Matte With Electrolytically Deposited Metallic Compound, Integrally Colored Coating Class I Architectural, 0.7 mil Thick Finish.

B. American Architectural Manufacturers Association (AAMA):
   1. 620-02 – Voluntary Specification for High Performance Organic Coatings on Coil Coated Architectural Aluminum.
   2. 621-02 – Voluntary Specification for High Performance Organic Coating on Coil Coatings on Coil Coated Architectural Hot Dipped Galvanized (HDG) and Zinc-Aluminum Coated Steel Substrates.

C. ASTM International (ASTM):
   1. A240/A240M – Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessels and for General Application.
   2. B209 – Aluminum and Aluminum-Alloy and Plate.
   3. D412 – Vulcanized Rubber and Thermoplastic Elastomers-Tension.
   4. D1187 – Asphalt Base Emulsions for Use as Protective Coatings for Metal.
   5. D1784 – Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.

D. Sheet Metal and Air Conditioning Contractors National Association (SMACNA): Architectural Sheet Metal Manual.

E. National Association of Architectural Manufacturers (NAAMM):
   1. AMP 500-06 – Metal Finishes Manual.

F. Federal Specification (Fed. Spec.):
   1. A-A-1925A – Shield, Expansion; (Nail Anchors).

1.04 SUBMITTALS

A. Submit in accordance with Section 01 33 00, SUBMITTALS.

B. Shop Drawings: For all specified items, including:
   1. Flashings.

C. Manufacturer's Literature and Data: For all specified items, including:
   1. Two-piece counterflashings.
   2. Thru wall flashings.

D. Samples: 6"x6" of all sheet metal. Labels for sheet metal shall be provided showing weights, gages and thicknesses.

E. Certificates: Indicating compliance with specified finishing requirements, from applicator and Contractor.

1.05 QUALITY ASSURANCE

A. All personnel concerned with the shop fabrication and field installation f sheet metal work must be qualified sheet metal journeymen who may be assisted by sheet metal apprentices qualifying for their journeymen status. The foreman of the crew must have at least five year's experience in sheet metal work.

1.06 PROJECT/SITE CONDITIONS

A. Work shall be performed only during dry weather and applied directly to dry surfaces with all materials entirely free of moisture.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Stainless Steel: ASTM A240, Type 302B, dead soft temper.

B. Aluminum Sheet: ASTM B209, alloy 3003-H14 except alloy used for color anodized aluminum shall be as required to produce specified color. Alloy required to produce specified color shall have the same structural properties as alloy 3003-H14.

C. The following list of materials are to be used at the locations as specified. All materials are to be of the best quality and finish. The following list may not be all inclusive. The Contractor shall reference the Drawings for items not specifically noted. If a discrepancy between the Drawings and Specifications exists, the more stringent of the two shall be considered the standard for the Project. The Contractor shall immediately bring any discrepancies to the attention of the Architect for review.

Location	Metal Type	Gauge	Finish	Color
Continuous Cleats	Aluminum	18 ga/.05”	Mill	Clear
Exposed Sill Flashing	Aluminum	18 ga/.05”	Painted	Color to match metal wall panels

D. Sheet metal flashings shall be shop fabricated. All breaks, bends and hems shall be uniform, clean, straight lines.

2.02 ACCESSORIES

A. Bituminous Paint: ASTM D1187, Type I.

B. Sealant: As specified in Section 07 90 00, SEALANTS AND CAULKING for exterior locations.

C. Fasteners:
1. For attaching sheet metal to masonry, use 1/8” diameter rivets or rawl plugs.
2. For attaching sheet metal to wood, use 3/8” diameter head, 12 ga. annular ring nail of sufficient length to provide 7/8” embedment into the substrate.

3. Cleats are to be continuous, of same thickness of, and compatible with attached material.
4. To prevent corrosion, the indicated fastener materials shall be used with the following metals:

Sheet Metal	Nails	Screws	Rivets
Aluminum	Aluminum or zinc	Aluminum or zinc	Aluminum or zinc

2.03 FABRICATION

A. Jointing:
   1. Joints shall conform to the following requirements:
      a. Flat-lock joints shall finish not less than ¾ inch wide.
      b. Lap joints subject to stress shall finish not less than one inch wide and shall be riveted.
      c. Lap joints shall finish not less than 4 inches wide.
   2. Flat and lap joints shall be made in direction of flow.

B. Expansion and Contraction Joints:
   1. Fabricate in accordance with the Architectural Sheet Metal Manual recommendations for expansion and contraction of sheet metal work in continuous runs.
   2. Space joints as shown or as specified.
   3. Space expansion and contraction joints for aluminum at intervals not exceeding 18 feet.
   4. Fabricate slip-type or loose locked joints and fill with sealant unless otherwise specified.
   5. Fabricate joint covers of same thickness material as sheet metal served.

C. Cleats:
   1. Fabricate cleats to secure flashings and sheet metal work over 12 inches wide and where specified.
   2. Provide cleats for maximum spacing of 12 inch centers unless specified otherwise.
   3. Form cleats of same metal and weights or thickness as the sheet metal being installed unless specified otherwise.
   4. Fabricate cleats from 2 inch wide strip. Form end with not less than ¾ inch wide loose lock to item for anchorage. Form other end edge to be folded over and cover nail heads.

D. Continuous Cleats:
   1. Fabricate continuous edge strips where shown and specified to secure loose edges of the sheet metal work.
   2. Use material compatible with sheet metal to be secured by the edge strip.

3. Fabricate in 10 foot maximum lengths with not less than ¾ inch loose lock into metal secured by edge strip.

4. Fabricate anchor edge maximum width of 3 inches or of sufficient width to provide adequate bearing area to insure a rigid installation.

2.04 FINISHES

A. Use same finish on adjacent metal or components and exposed metal surfaces unless specified or shown otherwise.

B. In accordance with NAAMM Metal Finishes Manual AMP 500, unless otherwise specified.

C. Finish exposed metal surfaces as follows, unless specified otherwise:
   1. Aluminum: AA-C22A44 (electrolytically deposited metallic compound) medium matte, Integrally colored coating, Class I Architectural, 0.7 mils thick. Dyes will not be accepted.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General:
   1. Install flashing and sheet metal items as shown in Sheet Metal and Air Conditioning Contractors National Association, Inc., publication, ARCHITECTURAL SHEET METAL MANUAL, except as otherwise shown or specified.
   2. Apply sealant as specified in Section 07 90 00, SEALANTS AND CAULKING, except as otherwise shown or specified.
   3. Apply sheet metal and other flashing material to surfaces which are smooth, sound, clean, dry and free from defects that might affect the application.
   4. Remove projections which would puncture the materials and fill holes and depressions with material compatible with the substrate. Cover holes or cracks in wood wider than ¼ inch with sheet metal compatible with the flashing material being used.
   5. Coordinate with masonry work for the application of a skim coat of mortar to surfaces of unit masonry to receive flashing material before the application of flashing.
   6. Confine direct nailing of sheet metal to strips 12 inch or less wide. Nail flashing along one edge only. Space nail not over 4 inches on center unless specified otherwise.
   7. Install bolts, rivets, and screws where indicated, specified, or required in accordance with the SMACNA Sheet Metal Manual. Space rivets at 3 inch on

centers in two rows in a staggered position. Use neoprene washers under fastener heads when fastener head is exposed.

8. Nail continuous cleats 3 inch on centers in two rows in a staggered position.
9. Nail individual cleats with two nails and bend end tab over nail heads. Lock other end of cleat into hemmed edge.
10. Install flashings in conjunction with other trades so that flashings are inserted in other materials and joined together to provide a water tight installation.
11. Where required to prevent galvanic action between dissimilar metal, isolate the contact areas of dissimilar metal with coat of bituminous paint.
12. Isolate aluminum in contact with dissimilar metals other than stainless steel, white bronze or other metal compatible with aluminum by:
    a. Paint dissimilar metal with a prime coat of zinc-chromate or other suitable primer, followed by two coats of aluminum paint.
    b. Paint dissimilar metal with a coat of bituminous paint.
    c. Apply an approved caulking material between aluminum and dissimilar metal.
13. Paint aluminum in contact with or built into mortar, concrete, plaster, or other masonry materials with a coat of bituminous paint.
14. Paint aluminum in contact with absorptive materials that may become repeatedly wet with two coats of bituminous paint or two coats of aluminum paint.

3.02 EXPOSED SILL FLASHING

A. General:
1. Install exposed sill flashing over and in conjunction with installation of other work as specified or shown.
2. Use continuous cleats unless otherwise specified.
3. Flashing shall have loose lap joints not less than 4 inches and stagger joints with relationship to the other work construction joints.
4. When fastening to concrete or masonry, use screws driven in expansion shields set in concrete and masonry. Use screws to wood and sheet metal. Set fasteners in mortar joints of masonry work.

END OF SECTION

SECTION 07 72 53

SNOW GUARDS

PART 1 - GENERAL

1.01 SUMMARY

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 1 – GENERAL REQUIREMENTS, which are hereby made a part of this Section of the Specifications.

B. Section includes snow guards for metal roofs.

1.02 RELATED SECTIONS

A. Section 07 41 00, METAL ROOF PANELS.

1.03 REFERENCES

A. Aluminum Association (AA) - Aluminum Standards and Data, 2003 Edition.

B. ASTM International (ASTM):
1. B85 - Standard Specification for Aluminum-Alloy Die Castings.
2. B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

1.04 SUBMITTALS

A. Submit in accordance with Section 01 33 00, SUBMITTALS.

B. Shop Drawings: Include roof plans showing locations of snow guards on roof and attachment details and spacing.

C. Product Data:
1. Product description.
2. Construction details.
3. Material descriptions.
4. Individual component dimensions.
5. Finishes.
6. Installation instructions.

D. Samples:
   1. Clamp samples.
   2. 12-inch long cross member samples including all associated hardware.

E. Include calculation of number and location of snow guards based on designed roof snow load, roof slope, roof type, components, spacings and finish.

F. Test results: Results of product tensile load testing, issued by a recognized independent testing laboratory, showing ultimate load-to-failure value of attachment.

G. Certification: Installer's certification that snow guard system was installed in accordance with manufacturer's instructions and approved Shop Drawings.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Manufacturer to specialize in production of Snow Guard Products of the type specified with a minimum of 20 years documented experience.

B. Installer Qualifications: Installer to specialize in metal roof installation and installation of Snow Guard Products with a minimum of 5 years documented experience.

1.06 DELIVERY, STORAGE AND HANDLING

A. Deliver components to jobsite properly packaged to provide protection during transport, delivery and handling.

B. Store products in manufacturer’s original labeled and unopened packaging in a clean and dry location, protected from potential damage, until ready for application.

PART 2 - PRODUCTS

2.01 SYSTEM DESCRIPTION

A. Attachment system to provide attachment to standing seam metal roofs:
   1. With only minor dimpling of panel seams.
   2. Without penetrations through roof seams or panels.
   3. Without use of sealers or adhesives.
   4. Without voiding roof warranty.

B. Performance Requirements: Provide snow guards to withstand exposure to the weather and environmental elements, and resist design forces without failure due to defective manufacture.
   1. Loading: Design snow guard system to resist minimum in-service vector load as required by 780 CMR 9th edition.
   2. Factor of safety: Utilize a factor of safety ≥ 2 to determine allowable loads from ultimate tested clamp tensile load values.
   3. Source Limitation: Provide snow guard system as designed and tested by the manufacturer as a complete system. Install components by the same manufacturer.

2.02 MANUFACTURER

A. Manufacturer: S-5! Metal Roof Innovations, or approved equal.

2.03 BAR-RAIL SNO RETENTION SYSTEMS FOR STANDING SEAM METAL ROOFS

A. Basis of Design: ColorGard, manufactured by S-5! Metal Roof Innovations, Ltd.

B. Components:
   1. Clamps:
      a. Manufactured from 6061-T6 aluminum extrusions conforming to ASTM B221 or aluminum castings conforming to ASTM B85 and to AA Aluminum Standards and Data.
         1) Model No. S-5-H.
      b. Set screws: 300 Series stainless steel, 18-8 alloy, 3/8 inch diameter, with round nose point.
      c. Attachment bolts: 300 Series stainless steel, 18-8 alloy, 8 mm or 10 mm diameter, hex flange bolt.
   2. Cross Members:
      a. Manufactured from 6061-T6 or 6005-T5 alloy and temper aluminum extrusions conforming to ASTM B221 and AA Aluminum Standards and Data.
      b. Receptacle in face to receive color-matched metal strips.
      c. Provide splice connectors ensuring alignment and structural continuity at end joints.
   3. Color Strips: Same material and finish as roof panels; obtained from roof panel manufacturer.
   4. Snow and Ice Clips:
      a. Aluminum, with rubber foot, minimum 3 inches wide.
         1) Model: SnoClip II or SnapClip II for standing seam heights 1” to 1.75".
         2) Model: SnoClip III or SnapClip III for standing seam heights 1.75” to 3".

PART 3 - EXECUTION

3.01 EXAMINATION

A. Prior to beginning installation, verify that:
   1. Panel seaming is complete.
   2. Panel attachment is sufficient to withstand loads applied by snow guard system.
   3. Installation will not impeded roof drainage.

3.02 PREPARATION

A. Clean areas to receive attachments; remove loose and foreign matter that could interfere with installation or performance.

3.03 INSTALLATION

A. Install system in accordance with manufacturer's instructions and approved Shop Drawings.

B. Snow Retention System:
   1. Place clamps at maximum 32 inches on center or as required by in-service loads.
   2. Place clamps in straight, aligned rows.
   3. Place both set screws on same side of clamp.
   4. Tighten set screws to manufacturer's recommended torque. Randomly test set screw torque using calibrated torque wrench.
   5. Insert color-matched metal strips into cross members, staggering strips to cover cross member joints.
   6. Attach cross members to clamps; tighten bolts to manufacturer's recommended torque.
   7. Install splice connectors at cross member end joints.
   8. Do not cantilever cross members more than 4 inches beyond last clamp at ends.
   9. Install two SnoClips per panel between panel seams.
      a. SnoClips: slide onto cross member before securing cross member to clamps.

END OF SECTION

SECTION 07 84 00

FIRESTOPPING

PART 1 - GENERAL

1.01 SUMMARY

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 1 – GENERAL REQUIREMENTS, which are hereby made a part of this Section of the Specifications.

B. Closures of openings in walls, floors, and roof decks against penetration of flame, heat, and smoke or gases in fire resistant rated construction.

1.02 RELATED SECTIONS

A. Section 03 30 00, CAST IN PLACE CONCRETE.

B. Section 04 20 01, UNIT MASONRY.

C. Section, 07 41 00, METAL ROOF PANELS.

D. Section 07 42 00, METAL WALL PANELS.

E. Section 07 90 00, SEALANTS AND CAULKING.

F. Section 09 21 16, GYPSUM BOARD SYSTEM.

G. Section 09 22 00, NON-LOAD BEARING FRAMING SYSTEMS.

H. Section 13 34 19, PRE-ENGINEERED BUILDING.

I. Section 21 00 01, FIRE PROTECTION.

J. Section 22 00 01, PLUMBING.

K. Section 23 00 01, HVAC.

L. Section 26 00 01, ELECTRICAL.

1.03 REFERENCES

A. American National Standards Institute (ANSI):
   1. 263 – Fire Tests of Building Construction and Materials.
   2. 723 – Surface Burning Characteristics of Building Materials.
   3. 1479 – Standard for Fire Tests of Through-Penetration Firestops.
   4. 1709 – Rapid Rise Tests of Protection Materials for Structural Steel.
   5. 2079 – Tests for Fire Resistance of Building Joint Systems.

B. ASTM International (ASTM):
   1. E84 – Standard Test Method for Surface Burning Characteristics of Building Materials.
   2. E119 – Standard Test Methods for Fire Tests of Building Construction and Materials.
   3. E814 – Standard Test Method for Fire Tests of Through-Penetration Fire Stops.
   4. E1399 – Standard Test Method for Cyclic Movement and Measuring the Minimum and Maximum Joint Widths of Architectural Joint Systems.
   5. E1966 – Standard Test Method for Fire Resistive Joint Systems.
   6. E1529 – Standard Test Methods for Determining Effects of Large Hydrocarbon Pool Fires on Structural Members and Assemblies.
   7. E1725 – Standard Test Methods for Fire Tests of Fire-Resistive Barrier Systems for Electrical System Components.
   8. E2307 – Fire Tests of Perimeter Fire Barrier Systems Using Intermediate Scale, Multi-Story Tests Apparatus.

C. FM Global (FM) – FM4991 – Standard for Approval of Firestop Contractors.

D. International Code Congress (ICC):
   1. International Building Code (IBC).

E. National Fire Protection Association (NFPA):
   1. 70 – National Electric Code.
   2. 101 – Life Safety Code.

F. Underwriters Laboratories (UL):
   1. Through-Penetration Firestops Systems (XHEZ).
   2. Joint Systems (XHBN).
   3. Firestop Devices (XHJI).
   4. Forming Materials (XHKU).
   5. Wall Opening Protective Materials (CLIV).
   6. Fill, Void or Cavity Materials (XHHW).

1.04 PERFORMANCE REQUIREMENTS

A. Provide systems that are listed by at least one of the following:

1. Underwriters Laboratories (UL) in “Fire Resistance Directory”.
2. Intertek Testing Service (Formerly known as Omega Point Laboratories), in “Directory of Listed Products”.
3. Any other qualified independent testing and inspection agency that conducts periodic follow-up inspections and is acceptable to authorities having jurisdiction.

B. Provide firestop products that are flexible enough to allow for pipe vibration in a through penetration application.

C. Provide firestop sealants and sprays for construction joint applications that are flexible enough to satisfy the movement criteria per the test standards ASTM E1399, ASTM E1966 or ANSI/UL 2079.

D. Provide products that meet the intent of the L rating classification for the movement of smoke per ANSI/UL 1479 for through penetrations and ANSI/UL 2079 for construction joints.

E. Provide products identical to those tested and listed for classification by UL, Intertek or any other qualified independent testing agency.

F. Provide products that bear classification marking of qualified independent testing agency.

G. Where firestop systems not listed by any listing agency are required due to project conditions, submit a substitution proposal with evidence specified.

H. Use only products specifically listed for use in listed systems.

I. Provide products that are compatible with each other, with the substrates forming openings, and with the items, if any, penetrating the firestopping, under the conditions represented by this Project, based on testing and field performance demonstrated by manufacturer.

J. Firestopping materials must meet and be acceptable for use by all building codes and NFPA codes cited in this section.

1.05 SUBMITTALS

A. Submit in accordance with Section 01 33 00, SUBMITTALS.

B. Shop Drawings: For each firestopping system, provide the following:
1. Listing agency’s detailed drawing showing opening, penetrating items(s), and firestopping materials, identifying with listing agency’s name and number or designation and fire rating achieved.

2. For proposed systems that do not conform strictly to the listing, submit listing agency's drawing marked to show modifications and approved by firestop system manufacturer.

C. Product Certificates: Submit certificates of conformance signed by firestop system manufacturer certifying that materials furnished comply with requirements.

D. Product Data: Furnish manufacturer's product data sheets on each material to be used in firestop systems. Information on manufacturer's product data sheet should include:
1. Product characteristics including compliance with appropriate ASTM/UL/ANSI test standards.
2. Storage and handling requirements and recommendations.

E. Installation Instructions: Furnish manufacturer's installation instructions.

1.06 QUALITY ASSURANCE

A. General: All through-penetration firestop systems shall be installed with approved methods using materials that have been tested and classified to produce an approved assembly.

B. Manufacturer Qualifications: All primary products specified in this section will be suppled by a single manufacturer.

C. Installer Qualifications: Firm must be qualified by having experience, staff, and be properly trained to install the specified products, and meets the following criteria:
1. Contractor is acceptable to the manufacturer.
2. Contractor is acceptable to authority having jurisdiction.
3. Contractor has completed the manufacturer's certified product installation training.
4. Contractor should provide certificate of qualification.

D. Codes: Where manufacturer's application procedures are in conflict with those of the code authority having jurisdiction, the more strict guidelines will prevail.

1.07 DELIVERY, STORAGE AND HANDLING

A. Deliver and store products until ready for installation in manufacturer's original unopened packaging, legibly marked with manufacturer's name and product identification, date of manufacture, lot number, shelf life, listing agency's classification markings, curing time, and mixing instructions if applicable.

B. Store and handle in such a manner as to prevent deterioration or damage due to moisture, temperature changes, contaminants, and other causes; follow manufacturer's instructions.

C. Store and dispose of hazardous materials, and materials contaminated by hazardous materials, in accordance with requirements of local authorities having jurisdiction.

1.08 WARRANTY

A. At project closeout, provide to Owner an executed copy of the manufacturer's standard limited warranty against manufacturing defect, outlining its items, conditions, and exclusions from coverage.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Acceptable Manufacturers:
   1. Hilti, Inc.
   2. 3M Fire Protection Products.
   3. Specified Technologies, Inc.

2.02 SCOPE/APPLICATION

A. Provide installed firestop products that limit the spread of fire, heat, smoke, and gasses through otherwise unprotected openings in rated assemblies, including walls, partitions, floors, roofs/ceilings, and similar locations, restoring the integrity of the fire rated construction to its original fire rating.

B. Provide firestop systems listed for the specific combination of fire rated construction, type of penetrating item, annular space requirements, and fire rating, and the following criteria.
   1. F-Rating: Equal to or greater than the fire-resistance rating of the assembly in which the firestopping will be installed.
   2. T-Rating: In habitable areas where penetrating items are exposed to potential contact with materials on the fire sides(s) of rated assembly, T-rating must equal its F-rating.
   3. L-Rating: L-rating of 1 cfm per linear foot maximum at ambient temperatures.
   4. Wall Penetrations: Systems must be symmetrically, with the same rating from both sides of the wall.
   5. Testing: Determine ratings in accordance wit ASTM E814 or UL 1479.

C. Provide firestopping systems listed for construction gaps per the specific combination of fire-rated construction type, configuration, gap dimensions, and fire rating, and the following criteria:
   1. Fire resistance rating must be equal to or greater than that of the assembly in which it is to be installed.
   2. Movement capability must be appropriate to the potential movement of the gap, demonstrated by testing in accordance with ASTM E1399 for minimum of 500 cycles at 10 cycles per minute.
   3. L-Rating: L-rating of 1 cfm per linear foot maximum.
   4. Determine ratings in accordance with UL 2079.

2.03 MATERIALS

A. Use only firestop products that have been UL 1479, ASTM E814 or UL 2079 tested for specific fire-rated construction conditions conforming to construction assembly type, penetrating item type, annular space requirements, and fire-rated involved for separate instance.

B. The products listed as the basis of design are to establish quality and performance. Products of other acceptable manufacturers shall meet the characteristics of the listed products, subject to approval.

C. Preformed firestop devices for use with noncombustible and combustible pipes (closed and open systems), conduit, and/or cable bundles penetrating concrete floors, the following products are acceptable:
   1. Hilti Cast-In-Place Firestop Device (CP 680-P).
      a. Add Aerator Adapter when used in conjunction with aerator system.
   2. Hilti Cast-In-Place Firestop Device (CP 680-M) for use with noncombustible penetrants.
   3. Hilti Tub Box Kit (CP 681) for use with tub installers.
   4. Hilti Firestop Speed Sleeve (CP 653) for use with cable penetrations.
   5. Hilti Firestop Drop-In Device (CFS-DID) for use with noncombustible and combustible penetrants.
   6. Hilti Firestop Block (CFS-BL).
   7. Hilti Closet Stub (CFS-CID CS).

D. Sealants, caulking materials, or foams for use with non-combustible items including steel pipe, copper pipe, rigid steel conduit and electrical metallic tubing (EMT), the following products are acceptable:
   1. Hilti Intumescent Firestop Sealant (FS-ONE MAX).
   2. Hilti Fire Foam (CP 620).
   3. Hilti Flexible Firestop Sealant (CP 606).
   4. Hilti Firestop Silicone Sealant Gun Grade (CFS-S SIL GG).
   5. Hilti Firestop Silicone Sealant Self Leveling (CFS-S SIL SL).

E. Sealants or caulking materials for use with sheet metal ducts, the following products are acceptable:
   1. Hilti Firestop Silicone Sealant Gun Grade (CFS-S SIL GG).
   2. Hilti Firestop Silicone Sealant Self Leveling (CFS-S SIL SL).
   3. Hilti Flexible Firestop Sealant (CP 606).
   4. Hilti Intumescent Firestop Sealant (FS-ONE MAX).

F. Sealants, sprays, or pre-formed materials for use with fire-rated construction joints and other gaps, the following products are acceptable:
   1. Hilti Firestop Top Track Seal (CFS-TTS).
   2. Hilti Firestop Joint Spray (CFS-SP WB).
   3. Hilti Firestop Silicone Joint Spray (CFS-SP SIL).
   4. Hilti Flexible Firestop Sealant (CP 606).
   5. Hilti Firestop Silicone Sealant Gun Grade (CFS-S SIL GG).
   6. Hilti Firestop Silicone Sealant Self Leveling (CFS-S SIL SL).
   7. Hilti Bottom-Of-Wall Sealant (CP 605).

G. Pre-forrmed mineral wool designed to fill flutes of metal profile deck and gap between top of wall and metal profile deck, as a backer for spray material, the following products are acceptable:
   1. Hilti Speed Plugs (CP 777).
   2. Hilti Speed Strips (CP 767).

H. Intumescent sealants, caulking materials for use with combustible items (Penetrants consumed by high heat and flame) including insulated metal pipe, PVC jacketed, flexible cable or cable bundles and plastic pipe, the following products are acceptable:
   1. Hilti Intumescent Firestop Sealant (FS-ONE MAX).

I. Foams, intumescent sealants, or caulking materials for use with flexible cable or cable bundles, the following products are acceptable:
   1. Hilti Intumescent Firestop Sealant (FS-ONE MAX).
   2. Hilti Fire Foam (CP 620).
   3. Hilti Flexible Firestop Sealant (CP 606).
   4. Hilti Firestop Silicone Sealant Gun Grade (CFS-S SIL GG).
   5. Hilti Firestop Silicone Sealant Self Leveling (CFS-S SIL SL).

J. Non-curing, re-penetrable intumescent putty or foam materials for use with flexible cable or cable bundles, the following products are acceptable:
   1. Hilti Firestop Putty Stick (CP 618).
   2. Hilti Firestop Plug (CFS-PL).

K. Wall opening protective materials for use with UL listed metallic and specified nonmetallic outlet boxes, the following products are acceptable:
   1. Hilti Firestop Putty Pad (CFS-P PA).
   2. Hilti Firestop Putty Pad (CP 617).

3. Hilti Firestop Box Insert.

L. Firestop collar or wrap devices attached to assembly around combustible plastic pipe (closed and open piping systems), the following products are acceptable:
   1. Hilti Firestop Collar (CP 643N).
   2. Hilti Firestop Collar (CP 644).
   3. Hilti Wrap Strips (CP 648-E/648-S).

M. Materials used for large openings and complex penetrations made to accommodate cable trays and bundles, multiple steel and copper pipes, electrical busways in raceways, the following products are acceptable:
   1. Hilti Firestop Block (CFS-BL).
   2. Hilti Composite Sheet (CFS-COS).
   3. Hilti Firestop Mortar (CP 637).
   4. Hilti Fire Foam (CP 620).
   5. Hilti Firestop Board (CP 675T).

N. Non-curing, re-penetrable materials used for large size/complex penetrations made to accommodate cable trays and bundles, multiple steel and copper pipes, electrical busways in raceways, the following products are acceptable:
   1. Hilti Firestop Block (CFS-BL).
   2. Hilti Firestop Board (CP 675T).

O. Re-penetrable, round cable management devices for use with new or existing cable bundles penetrating gypsum or masonry walls, the following products are acceptable:
   1. Hilti Firestop Speed Sleeve (CP 653) with integrated smoke seal fabric membrane.
   2. Hilti Firestop Cable Collar (CFS-CC).
   3. Hilti Firestop Sleeve (CFS-SL SK).
   4. Hilti Retrofit Sleeve (CFS-SL RK) for use with existing cable bundles).
   5. Hilti Gangplate (CFS-SL GP) for use with multiple cable management devices.
   6. Hilti Gangplate Cap (CFS-SL GP CAP) for use at blank openings in gangplates for future penetrations.

P. Sealants or caulking materials used for openings between structurally separate sections of wall and floors, the following products are acceptable:
   1. Hilti Firestop Joint Spray (CFS-SP WB).
   2. Hilti Flexible Firestop Sealant (CP 606).
   3. Hilti Firestop Silicone Sealant Gun Grade (CFS-S SIL GG).
   4. Hilti Firestop Silicone Sealant Self Leveling (CFS-S SIL SL).

Q. For blank openings made in fire-rated wall or floor assemblies, where future penetration of pipes, conduits, or cables is expected, the following products are acceptable:
   1. Hilti Firestop Block (CFS-BL).
   2. Hilti Firestop Plug (CFS-PL).

R. For single or cable bundles up to one inch diameter penetrating gypsum, masonry, concrete walls or wood floor assemblies, the following products are acceptable:
   1. Hilti Firestop Cable Disc (CFS-D).

PART 3 - EXECUTION

3.01 EXECUTION

A. Do not begin installation until substrates have been properly prepared.

B. Conduct tests according to manufacturer's written recommendations to verify that substrates are free of oil, grease, rolling compounds, incompatible primers, loose mill scale, dirt and other foreign substances capable of impairing bond of firestopping.

C. Verify that items penetrating fire rated assemblies are securely attached, including sleeves, supports, hangers and clips.

D. Verify that openings and adjacent areas are not obstructed by construction that would interfere with installation of firestopping, including ducts, piping, equipment, and other suspended construction.

E. Verify that environmental conditions are safe and suitable for installation of firestopping.

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

3.02 PREPARATION

A. Prepare substrates in accordance with manufacturer's instructions and recommendations.

B. Install masking and temporary coverings as required to prevent contamination or defacement of adjacent surfaces due to firestopping installation.

3.03 INSTALLATION

A. Install in strict accordance with manufacturer's detailed installation instructions and procedures.

B. Install so that openings are completely filled and material is securely adhered.

C. Where firestopping surface will be exposed to view, finish to a smooth, uniform surface flush with adjacent surfaces.

D. After installation is complete, remove combustible forming materials and accessories that are not part of the listed system.

E. Repair or replace defective installations to comply with requirements.

F. At each through penetration, attach identification labels on both sides in location where label will be visible to anyone seeking to remove penetrating items or firestopping.

G. Clean firestop materials off surfaces adjacent to openings as work progresses, Using methods and cleaning materials approved in writing by firestop system manufacturer and which will not damage the surfaces being cleaned.

H. Notify authority having jurisdiction when firestopping installations is ready for inspection; obtain advance approval of anticipated inspection dates and phasing, if any, required to allow subsequent construction to proceed.

I. Do not cover firestopping with other construction until approval of authority having jurisdiction has been received.

3.04 FIELD QUALITY CONTROL

A. Owner may engage an independent testing agency to inspect installed firestopping and to perform reports indicating whether the installed work complies with the Contract Documents.

B. Notify testing agency at least 7 days prior to date when firestopping installation will be ready for inspection; obtain advance approval of general schedule and phasing, if any, required to allow subsequent construction to proceed.

3.05 CLEANING AND PROTECTION

A. Remove left over material and debris from Work area. Use necessary means to protect film before, during, and after installation.

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

C. Install identification Labels for Through Penetration and Construction Joint Systems: Pressure sensitive self-adhesive vinyl labels, preprinted with the following information:

1. The words “Warning – Through Penetration Firestop System – Do Not Disturb. Notify Building Management of Any Damage”.
2. Listing agency’s system number or designation.
3. System manufacturer’s name, address, and phone number.
4. Installer’s name, address, and phone number.
5. General contractor’s name, address, and phone number.
6. Date of installation.

3.06 SCHEDULE OF COMMON FIRESTOP SYSTEMS

Schedule of Joint Firestop Systems. Basis of Design HILTI, Inc.

Joint Type	F-Rating (Hr)	HILTI Basis of Design UL System	
		Joint Width Less than or Equal to 2”	Joint Width Greater than 2” Less than or Equal to 6”[4]
Concrete (Floor to Floor)	1	FF-D-1012, FF-D-1013[1]	FF-D-1012, FF-D-1013
	2	FF-D-1012, FF-D-1013[1]	FF-D-1012, FF-D-1013
	3	FF-D-1011, FF-D-1026[1]	FF-D-1011, FF-D-1026
	4	FF-D-1047	FF-D-1125
Concrete (Edge of Floor Slab to Wall)	1	FW-D-1011, FW-D-1012, FW-D-1013	FW-D-1011, FW-D-1012, FW-D-1013, FW-D-1021
	2	FW-D-1011, FW-D-1012, FW-D-1013	FW-D-1011, FW-D-1012, FW-D-1013, FW-D-1021
	3	FW-D-1011	FW-D-1011, FW-D-1021
	4	FW-D-1047	FW-D-1092
Concrete or Block Wall to Concrete Floor (Top of Wall)	1	N/A**	N/A**
	2	HW-D-0097[1]	HW-D-1009
	3	HW-D-1008[1], HW-D-0268	HW-D-1008
	4	HW-D-1042	HW-D-1103
Concrete or Block Wall to Concrete Over Fluted Metal Deck (Top-of-Wall)	1	HW-D=0098	N/A**
	2	HW-D-0080, HW-D-0081, HW-D-0098	HW-D-1037
	3	N/A**	N/A**
	4	HW-D-0294	N/A**
Gypsum Wall to Flat Concrete Floor (Top-of-Wall)	1	HW-D-0757, HW-D-0082, HW-D-0083, HW-D-0106, HW-D-0119	HW-D-1011, HW-D-1012, HW-D-1020
	2	HW-D-0757, HW-D-0082, HW-D-0083, HW-D-0106, HW-D-0119	HW-D-1011, HW-D-1012, HW-D-1020
	3	HW-D-0119	HW-D-1011, HW-D-1012, HW-D-1020
Gypsim Shaft Wall to (Top-of-Wall)	2	HW-D-0342 (FLAT CONCRETE) HW-D-0541. HW-D-0542 (CONCRETE OVER METAL DECK)	N/A**
Gypsum Shaft Wall to Concrete Floor (Bottom-of-Wall)	1	BW-S-0023	N/A**
	2	BW-S-0023	N/A**
Gypsum Wall to Concrete Floor (Bottom-of-Wall)	1	BW-S-0001, BW-S-0002, BW-S-0039	N/A**
	2	BW-S-0001, BW-S-0002, BW-S-0039	N/A**
Gypsum Wall to Concrete over Fluted Metal Deck (Top-of-Wall)	1	HW-D-0042*, HW-D-0049*, HW-D-0087*, HW-D-0089*, HW-D-0045, HW-D-0046*, HW-D-0076*, HW-D-0077*, HW-D-0154, HW-D-0184*, HW-D-0292, HW-D-0295, HW-D-0538*	HW-D-1011, HW-D-1012, HW-D-1020
	2	HW-D-0042*, HW-D-0049*, HW-D-0087*, HW-D-0089*, HW-D-0045, HW-D-0046*, HW-D-0076*, HW-D-0077*, HW-D-0154, HW-D-0184*, HW-D-0292, HW-D-0295, HW-D-0538*	HW-D-1011, HW-D-1012, HW-D-1020

	3	HW-D-0292, HW-D-0295	HW-D-1011, HW-D-1012, HW-D-1020
	4	HW-D-0292, HW-D-0295	N/A**
Concrete (Wall-to-Wall)	2	WW-D-0017, WW-D-0082	WW-D-1080, WW-D-1084
	3	WW-D-1011[1], WW-D-0032	WW-D-1011
	4	WW-D-1047	WW-D-1128
Gypsum to Concrete (Wall-to-Wall)	1	WW-D-0040	N/A**
	2	WW-D-0040	N/A**

*SEE NOTE 3 **CONTACT HILTI FOR CURRENT UL CLASSIFIED SYSTEM OR ENGINEER JUDGEMENT DRAWING.
NOTES:
1. CLASSIFIED SYSTEMS FOR 2"-6" WIDE JOINTS MAY BE USED FOR JOINTS 2" WIDE AND LESS.
2. CONFIRM THAT MOVEMENT CAPABILITIES OF THE SELECTED UL SYSTEM MEETS OR EXCEEDS THE SPECIFIED MOVEMENT RANGE OF THE PARTICULAR JOINT.
3. SYSTEMS MARKED WITH ASTERIK (*) ARE SUITABLE FOR TOP-OF-WALL JOINTS WHERE THE FLUTTED METAL DECK HAS SPRAY-ON MONOKOTE MK-6/HY FIREPROOFING.
4. VERIFY ALLOWABLE JOINT WIDTH ON SPECIFIED UL SYSTEM DRAWING.

Schedule of Through Penetration Firestop Systems. Basis of Design HILTI, Inc.

CONCRETE FLOORS			CONCRETE OR BLOCK WALLS		
TYPE OF PENETRANT	**F-RATING (HR)**	**BASIS OF DESIGN UL SYSTEM**	**TYPE OF PENETRANT**	**F-RATING (HR)**	**BASIS OF DESIGN UL SYSTEM**
CIRCULAR BLANK OPENINGS	1	F-A-0006,C-AJ-0055,C-AJ-0090	CIRCULAR BLANK OPENINGS	1	C-AJ-0055,C-AJ-0090
	2	F-A-0006,C-AJ-0055,C-AJ-0090		2	C-AJ-0055,C-AJ-0090
	3	F-A-0006,C-AJ-0055,C-AJ-0086		3	C-AJ-0055,C-AJ-0086
SINGLE METAL PIPES OR CONDUIT	1	C-AJ-1226,F-A-1028,F-A-1017	SINGLE METAL PIPES OR CONDUIT	1	C-AJ-1226,W-J-1067,W-J-1020
	2	C-AJ-1226,F-A-1028,F-A-1017		2	C-AJ-1226,W-J-1067,W-J-1020,W-J-1248
	3	C-AJ-1226,F-A-1017		3	C-AJ-1226,W-J-1041,W-J-1068
	4	C-BJ-1037,C-BJ-1034		4	C-BJ-1034,C-BJ-1037,W-J-1041,W-J-1042,W-J-1068
SINGLE NON-METALLIC PIPE OR CONDUIT (I.E. PVC,CPVC,ABS,FRP,ENT)	1	F-A-2053,F-A-2025,C-AJ-2109,C-AJ-2098,C-AJ-2271,C-AJ-2167	SINGLE NON-METALLIC PIPE OR CONDUIT (I.E. PVC,CPVC,ABS,FRP,ENT)	1	C-AJ-2109,C-AJ-2098,C-AJ-2167,C-AJ-2371,C-AJ-2342
	2	C-AJ-2098,C-AJ-2271,C-AJ-2167,C-BJ-2021,C-AJ-2371,C-AJ-2342		2	C-AJ-2109,C-AJ-2098,C-AJ-2167,C-AJ-2371,C-AJ-2342
	3	F-A-2054,C-AJ-2109,C-AJ-2098,C-AJ-2371,C-AJ-2342		3	C-AJ-2109,C-AJ-2098,C-AJ-2371,C-AJ-2342
	4	C-BJ-2016,C-AJ-2017		4	W-J-2057,W-J-2091
SINGLE/CABLE BUNDLES	1	F-A-3007,C-AJ-3095,C-AJ-3180,C-AJ-3283	SINGLE/CABLE BUNDLES	1	W-J-3036,C-AJ-3095,C-AJ-3180,W-J-3060,W-J-3167
	2	F-A-3007,C-AJ-3095,C-AJ-3334,F-A-3060		2	W-J-3036,C-AJ-3095,C-AJ-3180,W-J-3060,W-J-3167,W-J-3189
	3	F-A-3007,C-AJ-3095,C-AJ-3285		3	C-AJ-3095,C-AJ-3180,W-J-3167
				4	W-J-3050
CABLE TRAY	1	C-AJ-4034,C-AJ-4035	CABLE TRAY	1	W-J-4027,C-AJ-4034,C-AJ-4035
	2	C-AJ-4034,C-AJ-4035		2	W-J-4027,C-AJ-4034,C-AJ-4035
	3	C-AJ-4034,C-AJ-4035		3	C-AJ-4034,C-AJ-4035
				4	W-J-8007
SINGLE INSULATED	1	F-A-5015,F-A-	SINGLE INSULATED	1	C-AJ-4090,C-AJ-

PIPES		5017,C-AJ-5090,C-AJ-5091,C-AJ-5048	PIPES		5091,C-AJ-5061,W-J-5042
	2	F-A-5015,F-A-5017,C-AJ-5090,C-AJ-5091,C-AJ-5048		2	C-AJ-4090,C-AJ-5091,C-AJ-5061,W-J-5042
	3	F-A-5016,C-AJ-5090,F-A-5018		3	C-AJ-5090,C-AJ-5061
	4	C-BJ-5006		4	C-BJ-5006,W-J-5028
ELECTRICAL BUSWAY	1	C-AJ-6006,C-AJ-6017,F-A-6002,C-AJ-6036	ELECTRICAL BUSWAY	1	C-AJ-6006,C-AJ-6017,C-AJ-6036
	2	C-AJ-6006,C-AJ-6017,F-A-6002,C-AJ-6036		2	C-AJ-6006,C-AJ-6017,C-AJ-6036
	3	C-AJ-6006,C-AJ-6017		3	C-AJ-6006,C-AJ-6017
MECHANICAL DUCTWORK WITHOUT DAMPERS NON-INSULATED	1	C-AJ-7046,C-AJ-7051,C-AJ-7084	MECHANICAL DUCTWORK WITHOUT DAMPERS NON-INSULATED	1	C-AJ-7046,C-AJ-7051,W-J-7021,W-J-7022
	2	C-AJ-7046,C-AJ-7051,C-AJ-7085		2	C-AJ-7046,C-AJ-7051,W-J-7021,W-J-7022
	3	C-AJ-7046,C-AJ-7051		3	C-AJ-7046,C-AJ-7051
MECHANICAL DUCTWORK WITHOUT DAMPERS INSULATED	N/A**	N/A/**	MECHANICAL DUCTWORK WITHOUT DAMPERS INSULATED	1	W-J-7029,W-J-7124
				2	W-J-7091,W-J-7112,W-J-7124
MIXED PENETRANTS	1	C-AJ-8099,C-AJ-8056,C-AJ-8143	MIXED PENETRANTS	1	C-AJ-8099,C-AJ-8056,W-J-8007,C-AJ-8143
	2	C-AJ-8099,C-AJ-8056,C-AJ-8143		2	C-AJ-8099,C-AJ-8056,W-J-8007,C-AJ-8143
	3	C-AJ-8099,C-AJ-8056		3	C-AJ-8041,C-AJ-8056,W-J-8007,C-AJ-8099
	4	C-AJ-8095		4	C-AJ-8095,W-J-8007
WOOD FLOORS			**GYPSUM WALLS**		
TYPE OF PENETRANT	**F-RATING (HR)**	**BASIS OF DESIGN UL SYSTEM**	**TYPE OF PENETRANT**	**F-RATING (HR)**	**BASIS OF DESIGN UL SYSTEM**
METAL PIPES OR CONDUIT	1	F-C-1009,F-C-1059,F-C-1168	METAL PIPES OR CONDUIT	1	W-L-1054,W-L-1058,W-L-1164,W-L-1506
	2	F-C-1009,F-C-1059,F-C-1168		2	W-L-1054,W-L-1058,W-L-1164,W-L-1506
				4	W-L-1110,W-L-1111,W-L-1165
NON-METALLIC PIPE OR CONDUIT	1	F-C-2232,F-C-2030,F-C-2160,F-C-2389	NON-METALLIC PIPE OR CONDUIT	1	W-L-2078,W-L-2075,W-L-2128
	2	F-C-2028,F-C-2030,F-C-2128,F-C-2160		2	W-L-2078,W-L-2075,W-L-2128
				4	W-L-2184,W-L-2245
SINGLED OR BUNDLED CABLES	1	F-C-3012,F-C-3110,F-C-3044	SINGLED OR BUNDLED CABLES	1	W-L-3065,W-L-3111,W-L-3112,W-L-3334,W-L-3414,W-L-3396
	2	F-C-3012,F-C-3110		2	W-L-3065,W-L-3111,W-L-3112,W-L-3334,W-L-3414,W-L-

					3396
				3	W-L-3385,W-L-3277
				4	W-L-3139,W-L-3334
INSULATED PIPES	1	F-C-5004,F-C-5037,F-C-5036	CABLE TRAY	1	W-L-4011,W-L-4019,W-L-4081
				2	W-L-4011,W-L-4019,W-L-4081
				4	W-L-8014
	2	F-C-5004,F-C-5037	INSULATED PIPES	1	W-L-5028,W-L-5029,W-L-5047
				2	W-L-5028,W-L-5029,W-L-5047
				4	W-L-5073
NON-INSULATED MECHANICAL DUCTWORK WITHOUT DAMPERS	1	F-C-7013	NON-INSULATED MECHANICAL DUCTWORK WITHOUT DAMPERS	1	W-L-7017,W-L-7040,W-L-7042,W-L-7155
				2	W-L-7040,W-L-7042,W-L-7155
INSULATED MECHANICAL DUCTWORK WITHOUT DAMPERS	1	N/A**	INSULATED MECHANICAL DUCTWORK WITHOUT DAMPERS	1	W-L-7059,W-L-7153,W-L-7156,W-L-7151
	2	N/A**		2	W-L-7059,W-L-7153,W-L-7156,W-L-7151
MIXED PENETRANTS	1	F-C-8009,F-C-8014,F-C-826	MIXED PENETRANTS	1	W-L-1095,W-L-8013
				2	W-L-1095,W-L-8013
				4	W-L-8014

END OF SECTION

SECTION 07 90 00

SEALANTS AND CAULKING

PART 1 - GENERAL

1.01 SUMMARY

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 1 – GENERAL REQUIREMENTS, which are hereby made a part of this Section of the Specifications.

B. This section specifies interior and exterior sealant and their application.

1.02 RELATED SECTIONS

A. Section 03 30 00, CAST IN PLACE CONCRETE.

B. Section 04 20 01, UNIT MASONRY.

C. Section 06 61 00, SOLID POLYMER FABRICATIONS.

D. Section 07 42 00, METAL WALL PANELS.

E. Section 08 11 00, STEEL DOORS AND FRAMES.

F. Section 08 40 00, FIBERGLASS REINFORCED PANEL (FRP) DOORS AND FRAMES.

G. Section 08 54 13, FIBERGLASS WINDOWS.

H. Section 08 81 00, GLASS AND GLAZING.

I. Section 08 91 00, LOUVERS.

1.03 REFERENCES

A. ASTM International (ASTM):
   1. C510 – Standard Test Method for Staining and Color Change of Single or Multicomponent Joint Sealants.
   2. C661 – Standard Test Method for Indentation Hardness of Elastomeric Type Sealants by Means of Durometer.

3. C719 – Standard Test Method for Adhesion and Cohesion of Elastomeric Joint Sealants Under Cyclic Movement (Hockman Cycle).
4. C794 – Test Method for Adhesion-in-Peel of Elastomeric Joint Sealants.
5. C834 – Specification for Latex Sealants.
6. C920 – Specification for Elastomeric Joint Sealants.
7. C1087 – Test Method for Determining Compatibility of Liquid-Applied Sealants with Accessories Used in Structural Glazing Systems.
8. C1193 – Guide for Use of Joint Sealants.
9. C1247 – Standard Test Method for Durability of Sealants Exposed to Continuous Immersion in Liquids.
10. C1248 – Test Method for Staining of Porous Substrate by Joint Sealants.
11. C1311 – Specification for Solvent Release Sealants.
12. C1330 – Cylindrical Sealant Backing for Use with Cold Liquid Applied Sealants.
13. D412 – Test Methods for Vulcanized Rubber and Thermoplastic Elastomers – Tension.
14. D624 – Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers.
15. D2203 – Standard Test Method for Staining from Sealants.
16. D2240 – Test Method for Rubber Property – Durometer Hardness.

B. California Department of Public Health:
   1. Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers.

C. NSF International (NSF):
   1. Standard 51 – Food Equipment Materials.

D. Sealant, Waterproofing, and Restoration Institute (SWRI):
   1. SWRI Validation Program.

E. U.S. Environmental Protection Agency (EPA):
   1. 40 CFR 59, Subpart D – National Volatile Organic Compound Emission Standards for Architectural Coatings.

F. U.S. Food and Drug Administration (FDA):
   1. 21 CFR 117.2600 – Title 21 Part 177 Indirect Food Additives: Polymers.

G. US Green Building Council (USGBC):
   1. Leadership in Energy and Environmental Design (LEED) Green Building Rating System.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate installation of joint sealants with cleaning of joint sealant substrates and other operations that may impact installation or finished joint sealant work.

1.05 SUBMITTALS

A. Submit in accordance with Section 01 33 00, SUBMITTALS.

B. Product Data:
   1. Preparation instructions and recommendations.
   2. Standard drawings illustrating manufacturer's recommended sealant joint profiles and dimensions applicable to Project.

C. Samples for Color Selection: For each joint sealant type.

D. Samples for Verification: For each exterior joint sealant product, for each color selected.

E. Greenguard Certificates: For each sealant and accessory product specified to meet volatile organic emissions standards for the Greenguard Children and Schools Certification.

F. Sealant, Waterproofing, and Restoration Institute (SWRI) Validation Certificate: For each sealant specified to be validated by SWRI's Sealant Validation Program.

G. Warranty: Sample of unexecuted manufacturer and installer specified warranties.

H. Preconstruction Compatibility and Adhesion Test Reports: From manufacturer. Include written interpretation of reports and recommendations for primers and substrate preparation.

I. Preconstruction field-adhesion test reports.

J. Joint Sealant Schedule: Include application, location, drawing designation, manufacturer and product name, and selected color.

K. Field quality control adhesion test reports.

1.06 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has specialized in installing joint sealants similar in material, design, and extent to those indicated for this Project ad whose work has resulted in joint-sealant installations with a record of successful in-service performance.

B. Single Source Responsibility: Provide exterior joint sealants by a single manufacturer responsible for testing of Project substrates to verify compatibility and adhesion of joint sealants.

C. Preconstruction Manufacturer Laboratory Compatibility, Staining, and Adhesion Testing: Submit samples for each substrate or adjacent material that will be in contact with or affect joint sealants. Current manufacturer test data of products on matching substrates will be acceptable.
   1. Adhesion: Use ASTM C719 and ASTM C794 to determine requirements for joint preparation, including cleaning and priming.
   2. Compatibility: Use ASTM C1087 to determine materials forming joints and adjacent materials do not adversely affect sealant materials and do not affect sealant color.
   3. Stain Testing: Use ASTM C510, ASTM C1248, or ASTM D2203 to verify non-staining characteristics or proposed sealants on specified substrates.
   4. Immersion Adhesion: Use ASTM C1247 to determine performance of proposed immersed sealant in contact with potable water.
   5. Pre-construction manufacturer laboratory testing is not required when sealant manufacturer can furnish data acceptable to Architect based on previous testing for materials matching those of the Work.

D. Mockups: Provide joint sealant application within mockups required in other sections identical to specified joint sealants and installation methods.

1.07 DELIVERY, STORAGE AND HANDLING

A. Acceptable materials on site in manufacturer's unopened original packaging.

B. Store primers and sealants in dry location with ambient temperature range of 60 to 80°F.

1.08 ENVIRONMENTAL REQUIREMENTS

A. Do not install primers or sealants when atmospheric temperatures or joint surface temperatures are less than 40°F.

1.09 SCHEDULING

A. Schedule work so waterproofing, water repellents and preservative finishes are installed after sealants, unless sealant manufacturer approves otherwise in writing.

B. Ensure sealants are cured before covering with other materials.

1.10 WARRANTY

A. Manufacturer's Warranty: Manufacturer's standard form in which joint sealant manufacturer agrees to furnish joint sealants to repair or replace those that demonstrate deterioration or adhesive or cohesive failure under normal use within warranty period specified.
   1. Five years from date of Substantial Completion.

B. Installer's Warranty: Original statement on Installer's letterhead in which Installer agrees to repair or replace joint sealants that demonstrate deterioration or failure within warranty period specified.
   1. Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Acceptable Manufacturers:
   1. Tremco, Inc.
   2. Pecora Corp.
   3. Dow Corning Corp.

2.02 MATERIALS, GENERAL

A. The products listed as the basis of design are to establish quality and performance. Products of other acceptable manufacturers shall meet the characteristics of the listed products, subject to approval.

B. VOC Content for Interior Applications: Provide sealants and sealant primers complying with the following VOC content limits per 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.

C. Low-Emitting Sealants for Interior Applications: Provide sealants and sealant primers complying with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

D. Compatibility: Provide joint sealants and accessory materials that are compatible with one another, and with adjacent materials, as demonstrated by sealant manufacturer using ASTM C1087 testing and related experience.

E. Joint Sealant Standard: Comply with ASTM C920 and other specified requirements for each joint sealant.

F. Stain Test Characteristics: Where sealants are required to be nonstaining, provide sealants tested per ASTM C1248 as non-staining on porous joint substrates specified.

G. Food Contact Suitability: Where sealants are required to be suitable for contact with food provide sealants complying with 21 CFR 177.2600.

2.03 SILICONE JOINT SEALANTS

A. Single-Component, Nonsag, Non-Staining, Neutral-Curing Silicone Joint Sealant (S-1): ASTM C920, Type S, Grade NS, Class 50, Use NT; SWRI validated.
   1. Basis of Design Product: Tremco, Inc., Spectrem 2.
   2. Volatile Organic Compound (VOC) Content: 50 g/L maximum.
   3. Volatile Organic Emissions (VOE): Not greater than Greenguard Children & Schools Certification emissions levels.
   4. Staining, ASTM C1248: None on concrete, marbles, granite, limestone, and brick.
   5. Color: As selected by Architect from manufacturer's standard line of colors.

B. Mildew-Resistant, Single-Component, Acid-Curing Silicone Joint Sealant (S-2): ASTM C920, Type S, Grade NS, Class 25, Use NT.
   1. Basis of Design Product: Tremco, Inc., Tremsil 200 Sanitary.
   2. Volatile Organic Compound (VOC) Content: 1 g/L maximum.
   3. Volatile Organic Emissions (VOE): Not greater than Greenguard Children & Schools Certification emission levels.
   4. Color: As selected by Architect from manufacturer's standard line of colors.

2.04 URETHANE JOINT SEALANTS

A. Single-Component, Nonsag, Moisture-Cure, Polyurethane Joint Sealant (S-3): ASTM C920, Type S, Grade NS, Class 50, Use NT; Greenguard certified.
   1. Basis of Design Product: Tremco, Inc., Dymonic 100.
   2. Volatile Organic Compound (VOC) Content: 40 g/L maximum.
   3. Volatile Organic Emissions (VOE): Not greater than Greenguard Children & Schools Certification emissions levels.
   4. Tensile Strength ASTM D412: 350 to 450 psi.
   5. Percent Elongation ASTM D412: 800 to 900%.
   6. Modulus at 100% ASTM D412: 75 to 85 psi.
   7. Tear Strength ASTM D412: 65 to 75 psi.
   8. Smoke Developed ASTM E84: 5.
   9. Color: As selected by Architect from manufacturer's standard line of colors.

B. Multi-Component, Pourable, Traffic-Grade Polyurethane Joint Sealant (S-4): ASTM C920, Type M, Grade P, Class 35, USE T, O, and I.
   1. Basis of Design Product: Tremco, Inc., Vulkem 445SSl.
   2. Tensile Strength ASTM D412: 250 psi, at 100% elongation.
   3. Tear Strength ASTM D412: 35 pli.
   4. Adhesion to Concrete, After Water ASTM C794: 28 pli.
   5. Hardness ASTM C661: 40 durometer Shote A, minimum.
   6. Accelerated Weathering ASTM C793: Pass.
   7. Volatile Organic Compound (VOC) Content: 106 g/L maximum.
   8. Color: As selected by Architect from manufacturer's standard line of colors.

2.05 LATEX JOINT SEALANTS

A. Latex Joint Sealant (S-5): Siliconized acrylic latex, ASTM C834, Type OP, Grade NF.
   1. Basis of Design Product: Tremco, Inc., Tremflex 834.
   2. Volatile Organic Compound (VOC) Content: 35 g/L maximum.
   3. Volatile Organic Emissions (VOE): Not greater than Greenguard Children & Schools Certification emissions levels.
   4. Color: White, paintable.

2.06 ACCESSORIES

A. Cylindrical Sealant Backing: ASTM C1330, Type B non-absorbent, bi-cellualr material with surface skin, or Type O open-cell polyurethane, as recommended by sealant manufacturer for application.

B. Bond Breaker Tape: Polymer tape compatible with joint sealant and adjacent materials and recommended by sealant manufacturer.

C. Joint Substrate Primers: Substrate primer recommended by sealant manufacturer for application.

D. Cleaners: Chemical cleaners acceptable to joint sealant manufacturer.

E. Masking Tape: Non-staining, non-absorbent tape product compatible with joint sealants and adjacent joint surfaces.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine joint profiles and surfaces to determine if work is ready to receive joint sealants. Verify joint dimensions are adequate for development of sealant movement capability. Verify joint surfaces are clean, dry, and adequately cured. Proceed with joint sealant work once conditions meet sealant manufacturer's written recommendations.

3.02 PREPARATION

A. Joint Surface Cleaning: Clean joints prior to installing joint sealants using materials and methods recommended by sealant manufacturer. Comply with ASTM C1193.
   1. Remove curing compounds, laitance, form-release agents, dust, and other contaminants.
   2. Clean nonporous and porous surfaces utilizing chemical cleaners acceptable to sealant manufacturer.
   3. Protect elements surrounding the Work of this section from damage and disfiguration. Apply masking tape to adjacent surfaces when required to prevent damage to finishes from sealant application.

3.03 SEALANT APPLICATION

A. Sealant and Primer Installation Standard: Comply with ASTM C1193 and with manufacturer's written instructions.

B. Joint Backing: Select joint backing materials recommended by sealant manufacturer as compatible with sealant and adjacent materials. Install backing material at depth required to produce profile of joint sealant allowing optimal sealant movement.
   1. Install joint backing to maintain the following joint ratios:
      a. Joints up to ½ inch wide: 1:1 width to depth ratio.
      b. Joints greater than ½ inch wide: 2:1 width to depth ratio; maximum ½ inch joint depth.
   2. Install bond breaker tape over substrates when sealant backings are not used.

C. Masking: Mask adjacent surfaces to prevent staining or damage by contact with sealant or primer.

D. Joint Priming: Prime joint substrates when recommended by sealant manufacturer or when indicated by preconstruction testing or experience. Apply recommended primer using sealant manufacturer's recommended application techniques.

E. Liquid Sealant Application: Install sealants using methods recommended by sealant manufacturer, in depths recommended for application. Apply in continuous operation from bottom to top of joint vertically and horizontally in a single direction. Apply using adequate pressure to fill and seal joint width.

1. Tool sealants immediately with appropriately shaped tool to force sealants against joint backing and joint substrates, eliminating voids and ensuring full contact.
2. Install sealant free of air pockets, foreign embedded matter, ridges, and sags.
3. Tool exposed joint surfaces concave using tooling agents approved by sealant manufacturer for application.

F. Cleaning: Remove excess sealant using materials and methods approved by sealant manufacturer that will not damage joint substrate materials.
1. Remove masking tape immediately after tooling joint without disturbing seal.
2. Remove excess sealant from surfaces while still curing.

3.04 FIELD QUALITY CONTROL

A. Field-Adhesion Testing: Perform adhesion tests in accordance with manufacturer's instructions and with ASTM C1193, Method A.
1. Perform 5 tests for the first 1,000 feet of joint length for each kind of sealant and joint substrate, and one test for each 1,000 feet of joint length thereafter or one test per each floor per building elevation, minimum.
2. For sealant applied between dissimilar materials, test both sides of joint.

B. Remove sealants failing adhesion test, clean substrates, reapply sealants, and re-test. Test adjacent sealants to failed sealants.

C. Submit report of field adhesion testing to Architect indicating tests, locations, dates, results, and remedial actions taken.

3.05 SCHEDULE

A. Exterior Building Joints, Horizontal and Vertical:
1. Metal to Metal: Type S-3.
2. Metal to Masonry or Stone: Type S-3.
3. Masonry to Masonry or Stone: Type S-3.
4. Stone to Stone: Type S-3.
5. Cast Stone to Cast Stone: Type S-3.
6. Threshold Setting Bed: Type S-3.
7. Masonry Expansion and Control Joints: Type S-3.
8. Wood to Masonry: Type S-3.

B. Metal Reglets and Flashings:
1. Flashings to Wall: Type S-3.
2. Metal to Metal: Type S-3.

C. Sanitary Joints:
1. Walls to Plumbing Fixtures: Type S-2.

2. Counter Tops to Walls: Type S-2.
3. Pipe Penetrations: Type S-2.

D. Horizontal Traffic Joints:
1. Concrete Paving, Unit Pavers: Type S-4.

E. Interior Caulking:
1. Typical Narrow Joint ¼ inch or less at Walls and Adjacent Components: Type S-5.
2. Perimeter Doors, Windows, Access Panels which Adjoin Concrete or Masonry Surfaces: Type S-5.
3. Joints at Masonry Walls and Columns, Concrete Walls or Exterior Walls: Type S-5.
4. Perimeter Plaster or Gypsum Wallboard Walls: Type S-5.
5. Exposed Isolation Joints at Top of Full Height Walls: Type S-5.
6. Glass to Glass Joints: Type S-1.

END OF SECTION

SECTION 08 11 00

STEEL DOORS AND FRAMES

PART 1 GENERAL

1.01 DESCRIPTION

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 1 – GENERAL REQUIREMENTS, which are hereby made a part of this Section of the Specifications.

C. Terms relating to steel doors and frames as defined in ANSI A123.1 and as specified.

1.02 RELATED WORK

A. Section 04 20 01, UNIT MASONRY.

B. Section 06 10 00, ROUGH CARPENTRY.

C. Section 07 90 00, SEALANTS AND CAULKING.

D. Section 08 81 00, GLASS GLAZING.

E. Section 09 21 16, GYPSUM BOARD SYSTEM.

F. Section 09 22 00, NON-LOAD BEARING FRAMING SYSTEMS.

G. Section 09 90 10, PAINTING.

1.03 TESTING

A. Performed by an independent testing laboratory.

1.04 SUBMITTALS

A. Submit in accordance with Section 01 33 00, SUBMITTALS.

B. Product Data: Manufacturer's standard details and catalog data indicating compliance with referenced standards, and manufacturer's installation instructions.

C. Shop Drawings: Door, frame, and hardware schedule in accordance with SDI 111D. Show types, quantities, dimensions, specified performance, and design criteria, materials and similar data for each opening required.
   1. Indicate frame configuration, anchor types and spacing, location of cutouts for hardware, reinforcement, to ensure doors and frames are properly prepared and coordinated to receive hardware.
   2. Indicate door elevations, internal reinforcement, closure method, and cutouts for glass lights and louvers.

D. Certificates:
   1. Manufacturer's certification that products comply with referenced standards.

1.05 SHIPMENT

A. Prior to shipment label each door and frame to show location, size, door swing and other pertinent information.

B. Fasten temporary steel spreaders across the bottom of each door frame.

1.06 STORAGE AND HANDLING

A. Handle, store and protect products in accordance with the manufacturers printed instructions and ANSI/SDI A250.10 and NAAMM/HMMA 840.

B. Store doors vertically in a dry area, under a proper vented cover. Place on 4 inch high wood sills to prevent rust or damage. Provide 1/4-inch space between doors to promote air circulation.

C. Store frames in an upright position with heads uppermost under cover. Place on 4 inch high wood sills to prevent rust and damage. Store assembled frames five units maximum in a stack with 2 inch space between frames to promote air circulation.

D. Do not use non-vented plastic or canvas shelters to prevent rust or damage.

E. Should wrappers become wet, remove immediately.

1.07 QUALITY ASSURANCE

A. Fire Rated Doors and Frames: Underwriters' Laboratories and Warnock Hersey, labeled fire doors and frames:
   1. Label fire doors and frames in accordance with Underwriters Laboratories standard UL10C Positive Pressure Fire Tests of Door Assemblies.

2. Construct and install doors and frames to comply with current issue of NFPA 80.
3. Manufacture Underwriters' Laboratories labeled doors and frames under the UL Follow Up Service (FUS) and in strict compliance to UL procedures, and provide the degree of fire protection, heat transmission and panic loading capability indicated by the opening class.
4. Manufacture Intertek Testing Services / Warnock Hersey labeled doors and frames under the ITS/WH factory inspection program and in strict compliance to ITS/WH procedures, and provide the degree of fire protection capability indicated by the opening class.
5. Manufacture FM labeled doors and frames under the FM factory inspection program and in strict compliance to FM procedures, and provide the degree of fire protection, heat transmission and panic loading capability indicated by the opening class.
6. Affix a physical label or approved marking to each fire door or fire door frame, at an authorized facility as evidence of compliance with procedures of the labeling agency. Label embossment is not permitted.
7. Conform to applicable codes for fire ratings. It is the intent of this specification that hardware and its application comply or exceed the standards for labeled openings. In case of conflict between types required for fire protection, furnish type required by NFPA and UL.
8. Fire door assemblies in exit enclosures and exit passageways; maximum transmitted temperature end point rating of not more than 250 degrees F (121 degrees C) above ambient at the end of 30 minutes of the standard fire test exposure.

1.08 APPLICABLE PUBLICATIONS

A. Publications listed below form a part of this specification. Publications are referenced in the text by the basic designation only.

B. ANSI/NFPA 80 - Standard for Fire Doors and Windows.

C. ANSI/DHI A 115.IG - Installation Guide for Doors and Hardware.

D. ANSI/BHMA A 156 - Specifications for Hardware Preparations in Standard Steel Doors and Frames.

E. ANSI/BHMA A156.7 - Hinge Template Dimensions.

F. ANSI A 250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors and Hardware Reinforcing.

G. ANSI/SDI A 250.8 - SDI-100 Recommended Specifications for Standard Steel Doors and Frames.

H. ANSI A 250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames.

I. ANSI A 250.11 - Recommended Erection Instructions for Steel Frames.
   1. ANSI/UL 10C - Standard for Safety for Positive Pressure Fire Tests of Door Assemblies.
   2. ANSI / ICC 500 Standard for the Design and Construction of Storm Shelters.

J. ASTM A 366/A 366M - Standard Specification for Steel, Sheet, Carbon, Cold-Rolled, Commercial Quality.

K. ASTM A 653/A 653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

L. ASTM A 924 - Specification for General Requirements for Steel Sheet, Metallic Coated by the Hot Dip Process.

M. ASTM A 1008/1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable.

N. ASTM E 90 - Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions.

O. ASTM E 152 - Standard Methods of Fire Tests of Door Assemblies.

P. ASTM E 413 - Classification for Rating Sound Insulation.

Q. SDI-111 - Recommended Standard Details for Steel Doors & Frames.

R. NAAMM/HHMA-820 TN01 - Grouting Hollow Metal Frames.

S. NAAMM/HMMA - Hollow Metal Manufacturers Association.

T. NAAMM/HHMA-820 TN03 - Guidelines for Glazing of Hollow Metal Transom, Sidelight and Windows.

U. NAAMM/HMMA-840 - Guide Specification for Installation and Storage of Hollow Metal Doors and Frames.

V. NFPA 252 - Standard Method of Fire Tests of Door Assemblies.

PART 2 PRODUCTS

2.01 MATERIALS

A. Stainless Steel: ASTM A167, Type 302 or 304; finish, NAAMM Number 4.

B. Sheet Steel: ASTM A366, cold-rolled, stretcher leveled degree of flatness for panels (face sheets) of doors and panels.

C. Anchors, Fastenings and Accessories: Fastenings anchors, clips connecting members and sleeves from steel conforming to ASTM A525, zinc coated.

D. Prime Paint: Paint that meets or exceeds the requirements of ANSI/SDI A224.1.

2.02 FABRICATION

A. Steel Frames:
1. Factory-welded frames: Head and jamb intersecting corners mitered at 45 degrees, with back welded joints ground smooth.
   a. Continuous face weld the joint between the head and jamb faces along their length either internally or externally. Grind, prime paint, and finish smooth face joints with no visible face seams.
2. Provide cutouts and reinforcements required for electrical and security components specified elsewhere in this specification.

2.03 DOORS

A. General: Construct interior doors to the following designs and gages.
1. Interior Doors: Cold-rolled steel, ASTM A 1008/A 1008M:
   a. Thickness: 16 gage.
2. Prime Finish Doors: Clean, phosphatize and factory prime painted doors.
3. Glass Moldings and Stops:
   a. Fabricate from 24 gage steel conforming to:
      1) ASTM A 366 cold rolled steel.
   b. Install trim into the door as a four sided welded assembly with mitered, reinforced and welded corners.
   c. Trim: identical on both sides of the door.
   d. Exposed fasteners are not permitted.
   e. Labeled and non-labeled doors: Use the same trim.
      1) Fit into a formed area of the door face, not extending beyond the door face, and interlocking into the recessed area.
      2) Cap the cutout not extend more than 1/16 inch (1.6 mm) from the door face.

4. Hardware Reinforcements:
   a. Hinge reinforcements for full mortise hinges: minimum 7 gage.
   b. Lock reinforcements: minimum 16 gage.
   c. Closer reinforcements: minimum 14 gage steel, 20-inch long.
   d. Projection welded hinge and lock reinforcements to the edge of the door.

e. Provided adequate reinforcements for other hardware as required.

B. Full Flush Doors:
1. Acceptable Product: Steelcraft L Series, or approved equal.
a. Performance:
1) Physical performance: 5 million cycles per ANSI A250.4.
2) Sound attenuation (gasketed):
a) Honeycomb core, 35 STC.
3) Thermal performance (gasketed), ASTM C1363:
a) Honeycomb core, 0.653 U-factor.
4) Thermal performance (gasketed), ASTM C236.
a) Honeycomb core, 0.363 U-factor.
2. Door Thickness: 1-3/4 inches.
3. Door faces reinforced and sound deadened as follows:
a. Honeycomb Core: Reinforced, stiffened, sound deadened and insulated with impregnated Kraft honeycomb core completely filling the inside of the doors and laminated to inside faces of both panels using contact adhesive applied to both panels and honeycomb core.
4. Vertical edge seams: Provide doors with continuous vertical mechanical interlocking joints at lock and hinge edges. Finish edges as follows:
a. Visible Interlocked Edge: Continuous vertical mechanical interlocking joints with visible edge seams and continuous bead of structural epoxy in internal vertical connection.
5. Bevel hinge and lock door edges 1/8 inch in 2 inches. Square edges on hinge and/or lock stiles are not acceptable.
6. Reinforce top and bottom of doors with galvannealed 14 gage , welded to both panels.
7. Glazing Bead: Formed steel sheet or snap-in Dezigner trim.

C. Fire Rated Full Flush Doors (Labeled):
1. Acceptable Product: Steelcraft T Series, or approved equal.
2. Door Thickness: 1-3/4 inches.
3. Mineral Fiber Core: Full 1-3/4 inches (45 mm) mineral fiber core material designed to comply with the 250 degrees F (121 degrees C) maximum temperature rise rating.
4. Vertical edge seams: Provide doors with continuous vertical mechanical interlocking joints at lock and hinge edges. Finish edges as follows:
a. Visible Interlocked Edge: Continuous vertical mechanical interlocking joints with visible edge seams and continuous bead of structural epoxy in internal vertical connection.
5. Bevel hinge and lock door edges 1/8 inch in 2 inches. Square edges on hinge and/or lock stiles are not acceptable.
6. Reinforce top and bottom of doors with galvannealed 14 gage, welded to both panels.
7. Fire Rating: Supply door units bearing Labels for fire ratings indicated in Door Schedule for the locations indicated.

2.04 DOOR FRAMES

A. General: Construct exterior/interior metal door frames to the following designs and gages:
   1. Interior Frames in Masonry: Zinc-Iron Alloy-Coated galvannealed steel, ASTM A 653, Class A60, galvannealed steel.
      a. Thickness: 14 gage.
   2. Interior Frames in stud wall construction: cold rolled steel, ASTM A 1008/A 1008M.
      a. Thickness: 14 gage.
   3. Electrical Requirements: Coordinate all electrical requirements for doors and frames. Make provisions for installation of electrical items so that wiring can be readily removed and replaced.
      a. Provide cutouts and reinforcements required for metal door frame to accept electric components.
      b. Frame with Electrical Hinges: Weld UL listed grout guard cover box welded over center hinge reinforcing. Top or bottom hinge locations are not permitted.
      c. Provide cutouts and reinforcements required to accept security system components.
      d. Coordinate with Section 08 71 00 - Door Hardware.

B. Flush Steel Frames:
   1. Acceptable Product: Steelcraft F Series, or approved equal.
   2. Performance: Physical Performance; 5 million cycles per ANSI A250.4.
   3. Construction: Factory welded three sided frames.
      a. Face welded: Weld miter joints between head and jamb faces completely along their length either internally or externally. The remaining elements of the frame profile (soffit, stop and rabbets) are not welded. Grind and finish face joints smooth.
   4. Profile: 2 inches (51 mm) face dimension with 5/8 inch high stop.
   5. Provide following reinforcement and accessories:
      a. Hinge Preparation for 4-1/2 inches high, standard weight, or heavy weight, full mortise hinges; with plaster guard.
      b. Strike preparation (single doors) for 4-7/8 inch universal strike; with plaster guard.
      c. Silencers. Prepare frames to receive inserted type door silencers, 3 per strike jamb on single doors, and 2 per head for pair of doors. Stick-on silencers are not permitted.
   6. Fire Rating: Supply frame units bearing Labels for fire ratings indicated in Door Schedule for the locations indicated.
   7. Finish: Factory prime finish in accordance with ANSI A 250.10.

C. Frame Anchors:

1. Floor anchors:
   a. Where floor fills occur, provide extension type floor anchors to compensate for depth of fill.
   b. At bottom of jamb use 0.053-inch thick steel clip angles welded to jamb and drilled to receive two 1/4-inch floor bolts.
2. Jamb anchors:
   a. Locate anchors on jambs near top and bottom of each frame, and at intermediate points not over 24 inches apart.
   b. Form jamb anchors of not less than 0.042-inch thick steel unless otherwise specified.
   c. Anchors for frames set in prepared openings:
      1) Drill jamb stop and strap spacers for tamper resistant 1/4-inch flat head bolts to pass through frame and spacers.
   d. Modify frame anchors to fit special frame and wall construction and provide special anchors where shown or required.

2.05 FINISHES

A. Chemical Treatment: Treat steel surfaces to promote paint adhesion.

B. Factory Prime Finish: Meet requirements of ANSI A 250.10.

C. Surface Preparation:
   1. Dress, fill and sand as required to make exposed surfaces smooth, level and free of irregularities.
   2. Clean off grease, dirt, oil and other foreign matter and treat surface as required for adhesion of primer.

D. Apply the prime paint on all surfaces of doors, frames and related components to provide a smooth, blemish free, uniform coating, free of holidays, sags, runs and streaks. Apply bituminous paint coating on interior of all door frames to be set in masonry.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that project conditions are acceptable before beginning installation of frames.
   1. Verify that completed openings to receive knock-down wrap-around frames are of correct size and thickness.

2. Verify that completed concrete or masonry openings to receive butt type frames are of correct size.

B. Do not begin installation until conditions have been properly prepared.

C. Correct unacceptable conditions before proceeding with installation.

3.02 INSTALLATION

A. Install doors and frames in accordance with manufacturer's printed installation instructions and with Steel Door Institute's recommended erection instructions for steel frames ANSI A250.11 and NAAMM/HMMA 840.

B. Provide full height 3/8 inch (9.5 mm) to 1-1/2 inch (38 mm) thick strip of polystyrene foam blocking at frames requiring grouting where continuous hinges are specified. Apply the strip to the back of the frame, where the hinge is to be installed, to facilitate field drilling or tapping.

C. Grouting Hollow Metal Frames:
1. Provide and install temporary bottom and intermediate wood spreaders to maintain proper width and avoid bowing or deforming of frame members. Refer to ANSI A250.11-2001 and NAAMM/HMMA 840.
2. Comply with ANSI/SDI Standard A250.8, paragraph 4.2.2, and HMMA 820 TN01 Grouting Hollow Metal Frames, whereby grout will be mixed to provide a 4 inch maximum slump consistency and hand toweled into place. Do not use grout mixed to a thinner, pumpable consistency.
3. Provide a vertical wood brace during grouting of frame at openings over 4 foot wide, to prevent sagging of frame header.

D. Plumb, align and brace frames securely until permanent anchors are set.
1. Use triangular bracing near each corner on both sides of frames with temporary wood spreaders at midpoint.
2. Use wood spreaders at bottom of frame if the shipping spreader is removed.
3. Protect frame from accidental abuse.
4. Where construction will permit concealment, leave the shipping spreaders in place after installation, otherwise remove the spreaders after the frames are set and anchored.
5. Remove wood spreaders and braces only after the walls are built and jamb anchors are secured.

E. Floor Anchors:
1. Anchor the bottom of door frames to floor with two 1/4-inch diameter expansion bolts.
2. Power actuated drive pins may be used to secure frame anchors to concrete floors.

F. Jamb Anchors:
1. Anchors in masonry walls: Embed anchors in mortar. Fill space between frame and masonry wall with grout or mortar as walls are built.
2. Coat frame back with a bituminous coating prior to lining of grout filling in masonry walls.
3. Secure anchors to sides of studs with two fasteners through anchor tabs. Use steel drill screws to steel studs.
4. Frames set in prepared openings of masonry or concrete: Expansion bolt to wall with 1/4-inch excpansion bolts through spacers. Where subframes or rough bucks are used, 1/4-inch expansion bolts on 24 inch centers or power activated drive pins 24-inches on centers.
5. At other than masonry walls, secure anchors to sides of studs with two fasteners through anchor tabs. Use steel drill screws to steel studs.

G. Fire Doors and Frames: Install in accordance with ANSI/NFPA 80.

3.03 FIELD QUALITY CONTROL

A. Fire-Rated Door Assembly Testing:
1. Upon completion of the installation, test each fire door assembly to confirm proper operation of its closing device and verify that it meets all criteria of a fire door assembly per NFPA 80 2007.
2. Perform inspections by individuals with documented knowledge and understanding of the operation components of the type of door being tested.
3. Provide a written record to the Owner with copies available to the Authorities Having Jurisdiction (AHJ).
4. Record shall list the fire door assembly and include the door number with an itemized list of hardware set components for each door opening and location in the facility.

3.04 ADJUST AND CLEAN

A. Adjust doors for proper operation, free from binding or other defects.

B. Clean and restore soiled surfaces. Remove scraps and debris and leave site in a clean condition.

C. Prime Coat Touch-Up: Immediately after erection, sand smooth rusted or damaged areas of prime coat, and apply touch-up of compatible air-drying primer.

3.05 PROTECTION

A. Protect installed products and finished surfaces from damage during construction.

3.06 INSTALLATION OF DOORS AND APPLICATION OF HARDWARE

A. Install doors and hardware as specified in Section 08 71 00, INSTALLATION OF DOORS AND HARDWARE.

END OF SECTION

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SECTION 08 33 23

ROLLING DOORS

PART 1 - GENERAL

1.01 DESCRIPTION

A. This section specifies materials and installation for overhead rolling doors.

B. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 1 – GENERAL REQUIREMENTS, which are hereby made a part of this Section of the Specifications.

1.02 RELATED WORK

A. Section 03 30 00, CAST IN PLACE CONCRETE.

B. Section 04 20 01, UNIT MASONRY.

C. Section 13 34 19, PRE-ENGINEERED BUILDING.

D. Section 26 00 00, ELECTRICAL.

1.03 SUBMITTALS

A. Submit in accordance with Section 01 33 00, SUBMITTALS.

B. Shop Drawings: The Contractor shall submit for review complete shop drawings (copies and one reproducible set) for overhead rolling doors including manufacturer's specifications, catalog cuts, anchoring/connection details, sizes and locations bolts, and other miscellaneous items detailing the installation of the rolling doors.

C. Manufacturer's Literature and Data: Submit manufacturer's written data and certificates on the physical characteristics for the following items:
   1. General product information on rolling doors.
   2. Electric motors and controls.

1.04 APPLICABLE PUBLICATIONS

A. ASTM A 653/A 653M – Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

B. ASTM A 36 – Standard Specification for Carbon Structural Steel, Hot Rolled Steel.

C. ASTM A 123 – Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

D. ASTM A 312 – Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes.

E. ASTM A 240 – Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.

F. ASTM A 276 – Standard Specification for Stainless Steel Bars and Shapes.

G. ASTM B 209 – Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

H. ASTM B 221 – Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

1.05 QUALITY ASSURANCE

A. Rolling doors shall be manufactured by a firm with a minimum of five years experience.

B. Single-Source Responsibility: Manufacturer shall provide doors, tracks, motors, and accessories for each type of door. Secondary components shall come from a source acceptable to the manufacturer of the primary components.

1.06 DELIVERY, STORAGE AND HANDLING

A. Deliver materials in original packaging supplied by manufacturer with intact labels. Store materials away from harmful environmental conditions and construction.

PART 2 - PRODUCTS

2.01 MANUFACTURER

A. Basis of Design: Wind-Tite by Alpine Overhead Doors, Inc.; 8 Hulse Road Suite 1S, East Setauket, NY 11733, or approved equal.

2.02 MATERIALS

A. Curatin:
   1. Slats: Constructed of interlocking, roll-formed 2-3/4" flat slats.
      a. Material: Galvanized steel, G90 coating exterior (G60 interior), Structural Quality Grade C per ASTM A653/A653M.
      b. Finish: Powder coated.
      c. Gauge: 22 gauge.
      d. Vision panels: 6" by 1-1/4" oval cut out with clear acrylic. Location and quantity as shown on Drawings.
      e. Slat cavity shall be filled with CFC-free foamed-in place polyurethane insulation.
   2. Endlocks and windlocks:
      a. Ductile cast iron, hot-dip galvanized endlocks/windlocks riveted (solid rivets, minimum ¼" thick) to ends of each slat to prevent lateral movement and to limit slat deflection and bending stress. Furnish windlocks based on windload specifications. Windlocks increase resistance to curtain jamming.
   3. Bottom bar:
      a. Two roll formed stainless steel angles, which extend into guides, designed to reinforce curtain bottom. Equip with vinyl weatherstrip.
         1) ASTM 240 stainless steel 300 Series.
   4. Design wind load: 20 psf without damage to door or assembly components in accordance with ASTM E 330.

B. Guides:
   1. Guides shall be designed using structural angles with a minimum thickness of 3/16", minimum 1 ¼" slotted connections, and removable bellmouth curtain stops to allow for curtain maintenance without removal of guides. Bellmouth stops shall be flush with guide groove. Guides shall be fastened with minimum 3/8" bolts at minimum 24" o.c. Equip with vinyl weather seals.
      a. Material: ASTM A36 Carbon Structural Steel, shop prime coat.

C. Door Support Brackets and Mounting Plates:
   1. Steel plate not less than 1/4" thick. Provide ball bearings at rotating support points. Bolt plates to wall mounting angles with minimum 1/2" fasteners. Plate supports counterbalance assembly and forms end enclosures.
      a. Material: ASTM A36 Carbon Structural Steel, shop prime coat.

D. Counterbalance Assembly: Torsion
   1. Counterbalance assembly: Steel pipe barrel of a size capable of carrying a curtain load with a maximum deflection of 0.03" per foot of door width. Heat-treated helical torsion springs encased in a steel pipe and designed to include an overload factor of 25% to ensure minimum effort to operate. Sealed and prelubricated high speed ball bearing at rotating support points. Torsion spring charge wheel for applying spring torque and for future adjustments.
      a. Material: ASTM A36 Carbon Structural Steel, shop prime coat.

E. Hood:

1. 24 gauge steel. Formed to fit the contour of the end brackets with reinforced top and bottom edges. Provide support bracing for doors wider than 20 feet at every 10 feet to prevent excessive sag. Equip with neoprene air baffle.
2. Shape: Square.
3. Galvanized Steel as per ASTM A 653/ A 653 M. Finish: Powder coated.

F. Locking:
1. Slide locks: Provide padlockable slide locks for latching and locking door on coil side bottom bar at each jamb extending into slots in guides.
2. Manual chain hoist: Provide padlockable chain keeper on guide.

2.03 OPERATION

A. Opening/Closing: Motor operator.

B. Manual Hand Chain:
1. Provide chain hoist operator with endless steel chain, chain pocket wheel and guard, geared reduction unit, and chain keeper secured to guide.

C. Motor Operator:
1. Motor: Heavy-duty, 1 horsepower, 110/240V single phase, continuous duty (with up to 60 cycles per minute), NEMA 56, instant reversing with automatic reset thermal overload. Totally enclosed motor. Note: Coordinate electrical requirements with electrician prior to submitting on motor.
2. Reversing Contractor: Heavy-duty electrically and mechanically interlocked.
3. Limit Switches: Adjustable rotary type synchronized with door.
4. Operator Controls: Interior surface mount, 24V, three-button "Open-Close-Stop". Provide radio control with one transmitter per door.
5. Reduction: Worm gear in oil bath.
6. Chain Hoist: With floor level disconnect and electrical interlock switch.
7. Clutch: Adjustable torque-limiter type.
8. Brake: Solenoid actuated drum type.
9. Mounting: Headplate and wall mount door drive is by chain and sprockets.
10. For motorized doors, sensing edges allow door to go up in case of obstruction.

2.04 MOUNTING

A. Interior face mounted.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that dimensions are correct and project conditions are in accordance with manufacturer's installation instructions; do not proceed with installation until unacceptable conditions have been corrected.

3.02 INSTALLATION

A. Install rolling doors in accordance with manufacturer's instructions and standards. Set work accurately, in alignment and where shown. Doors shall be plumb, level, free of rack and twist, and set parallel or perpendicular as required to line and plane of surface. Coordinate requirements of rolling doors with Pre-engineered building manufacturer.

B. Provide anchoring devices and fasteners as necessary for securing doors to building construction as specified.

C. Installation shall be by manufacturer's authorized representatives.

D. After installation, all exposed surfaces shall be cleaned as recommended by the manufacturer and protected from damage until completion of the project.

E. All movable parts, including motors, shall be cleaned and adjusted to operate as designed without binding or deformation of the members, so as to be centered in the opening of frame, and where applicable, to have all contact surfaces fit tight and even without forcing or warping the components.

3.03 FIELD TESTING

A. Test doors for regular operation.

END OF SECTION

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SECTION 08 36 13

SECTIONAL DOORS

PART 1 - GENERAL

1.01 DESCRIPTION

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 1 – GENERAL REQUIREMENTS, which are hereby made a part of this Section of the Specifications.

B. This section specifies materials and installation for overhead sectional doors

1.02 RELATED WORK

A. Section 03 30 00, CAST IN PLACE CONCRETE.

B. Section 04 20 01, UNIT MASONRY.

C. Section 05 50 00, METAL FABRICATIONS.

D. Section 13 34 19, PRE-ENGINEERED BUILDING.

E. Section 26 00 00, ELECTRICAL.

1.03 SUBMITTALS

A. Submit in accordance with Section 01 33 00, SUBMITTALS.

B. Shop Drawings: Indicate plans and elevations including opening dimensions and required tolerances, connection details, anchorage spacing, hardware locations, and installation details.

C. Product Data: Manufacturer's data sheets on each product to be used, including:
1. Preparation instructions and recommendations.
2. Storage and handling requirements and recommendations.
3. Installation methods.

D. Manufacturer's Certificates: Certify products meet or exceed specified requiremnets.

E. Operations and maintenance data.

1.04 APPLICABLE PUBLICATIONS

A. ANSI/DASMA 102 - American National Standard Specification for Sectional Overhead Type Doors.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum five years documented experience.

B. Installer Qualifications: Authorized representative of the manufacturer with minimum five years documented experience.

C. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories, Inc. acceptable to authority having jurisdiction as suitable for purpose specified.

1.06 DELIVERY, STORAGE AND HANDLING

A. Store products in manufacturer's unopened labeled packaging until ready for installation.

B. Protect materials from exposure to moisture until ready for installation.

C. Store materials in a dry, ventilated weathertight location.

1.07 PROJECT CONDITIONS

A. Pre-Installation Conference: Convene a pre-installation conference just prior to commencement of field operations, to establish procedures to maintain optimum working conditions and to coordinate this work with related and adjacent work.

1.08 DESIGN / PERFORMANCE REQUIREMENTS

A. Wind Loads: Design and size components to withstand loads caused by pressure and suction of wind acting normal to plane of wall as calculated in accordance with 780 CMR, 9th edition.
   1. Design pressure of 36 lb/sq ft.

B. Wiring Connections: Requirements for electrical characteristics.
   1. Coordinate with electrical subcontractor.

C. Single-Source Responsibility: Provide doors, tracks, motors, and accessories from one manufacturer for each type of door. Provide secondary components from source acceptable to manufacturer of primary components.

1.09 WARRANTY

A. Warranty: Manufacturer's limited door and operators System warranty for 10 year against delamination of polyurethane foam from steel face and all other components for 3 years or 20,000 cycles, whichever comes first.

PART 2 - PRODUCTS

2.01 MANUFACTURER

A. Basis of Design: Overhead Door Corp., 2501 S. State Hwy. 121, Suite 200, Lewisville, TX 75067, 592 Series Thermacore Insulated Steel Door, or approved equal.

2.02 INSULATED SECTIONAL OVERHEAD DOORS

A. Units shall have the following characteristics:
   1. Door Assembly: Metal/foam/metal sandwich panel construction, with PVC thermal break and weather-tight ship-lap design meeting joints.
      a. Panel Thickness: 2 inches.
      b. Exterior Surface: Ribbed, textured.
      c. Exterior Steel: .015 inch, hot-dipped galvanized.
      d. End Stiles: 16 gauge with thermal break.
      e. Spring Counterbalance: Sized to weight of the door, with a helically wound, oil tempered torsion spring mounted on a steel shaft; cable drum of diecast aluminum with high strength galvanized aircraft cable. Sized with a minimum 7 to 1 safety factor.
         1) High cycle spring: 25,000 cycles.
      f. Insulation: CFC-free and HCFC-free polyurethane, fully encapsulated.
      g. Thermal Values: R-value of 17.40; U-value of 0.057.
      h. Air Infiltration: 0.08 cfm at 15 mph; 0.08 cfm at 25 mph.
      i. Partial Glazing of Steel Panels:
         1) 1/2 inch (12.5 mm) Tempered Insulating Glass.
   2. Finish and Color:
      a. Two coat baked-on polyester:
         1) Interior color, white.
         2) Exterior color, to match insulated metal wall panels.
   3. Windload Design: Provide to meet the Design/Performance requirements specified.

4. Hardware: Galvanized steel hinges and fixtures. Ball bearing rollers with hardened steel races.
5. Lock:
   a. Interior mounted slide lock with interlock switch for automatic operator.
6. Weatherstripping:
   a. EPDM bulb-type strip at bottom section.
   b. Flexible Jamb seals.
   c. Flexible Header seal.
7. Track: Provide track as recommended by manufacturer to suit loading required and clearances available.
   a. Type:
      1) Follow roof slope.
8. Manual Operation: Chain hoist.
9. Electric Motor Operation: Provide UL listed electric operator, size and type as recommended by manufacturer to move door in either direction at not less than 2/3 foot nor more than 1 foot per second. Operator shall meet UL325/2010 requirements for continuous monitoring of safety devices.
   a. Rating: 1/2 horsepower, single phase, 208V. NEMA 48. RHX True Gear Operator by Overhead Door, or approved equal.
   a. Entrapment Protection: Required for momentary contact, includes radio control operation.
      1) Pneumatic sensing edge up to 18 feet (5.5 m) wide. Constant contact only complying with UL 325/2010.
      2) Electric sensing edge monitored to meet UL 325/2010.
      3) Photoelectric sensors monitored to meet UL 325/2010.
   b. Operator Controls:
      1) Push-button operated control stations with open, close, and stop buttons.
      2) Surface mounting.
      3) Interior location.
      4) Radio control operation.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Do not begin installation until openings have been properly prepared.

B. Verify wall openings are ready to receive work and opening dimensions and tolerances are within specified limits.

C. Verify electric power is available and of correct characteristics.

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

3.02 PREPARATION

A. Clean surfaces thoroughly prior to installation.

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

3.03 INSTALLATION

A. Install overhead doors and track in accordance with approved shop drawings and the manufacturer's printed instructions.

B. Coordinate installation with adjacent work to ensure proper clearances and allow for maintenance.

C. Anchor assembly to wall construction and building framing without distortion or stress.

D. Securely brace door tracks suspended from structure. Secure tracks to structural members only.

E. Fit and align door assembly including hardware.

F. Coordinate installation of electrical service. Complete power and control wiring from disconnect to unit components.

3.04 CLEANING AND ADJUSTING

A. Adjust door assembly to smooth operation and in full contact with weatherstripping.

B. Clean doors, frames and glass.

C. Remove temporary labels and visible markings.

3.05 PROTECTION

A. Do not permit construction traffic through overhead door openings after adjustment and cleaning.

B. Protect installed products until completion of project.

C. Touch-up, damaged coatings and finishes and repair minor damage before Substantial Completion.

END OF SECTION

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SECTION 08 40 00

FIBERGLASS REINFORCED PANEL (FRP) DOORS AND FRAMES

PART 1 - GENERAL

1.01 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 1 – GENERAL REQUIREMENTS, which are hereby made a part of this Section of the Specifications.

B. Work Included: Provide labor, materials and equipment to complete the work of this Section including, but not limited to the following:
   1. Each type of door and frame shown in the drawings and schedules.

1.02 RELATED WORK

A. Section 03 30 00, CAST IN PLACE CONCRETE.

B. Section 04 20 01, UNIT MASONRY.

C. Section 05 50 00, METAL FABRICATIONS.

E. Section 06 10 00, ROUGH CARPENTRY.

F. Section 07 27 26, AIR BARRIER.

G. Section 07 42 00, METAL WALL PANELS.

H. Section 07 90 00, SEALANTS AND CAULKING.

I. Section 08 71 00, BUILDERS HARDWARE.

J. Section 13 34 19, PRE-ENGINEERED BUILDING.

1.03 REFERENCES

A. AAMA 1503-98 - Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections.
B. ANSI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors and Hardware Reinforcings.

C. ASTM B 117 - Operating Salt Spray (Fog) Apparatus.
D. ASTM B 209 - Aluminum and Aluminum-Alloy Sheet and Plate.
E. ASTM B 221 - Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
F. ASTM D 256 - Determining the Pendulum Impact Resistance of Notched Specimens of Plastics.
G. ASTM D 543 - Evaluating the Resistance of Plastics to Chemical Reagents.
H. ASTM D 570 - Water Absorption of Plastics.
I. ASTM D 638 - Tensile Properties of Plastics.
J. ASTM D 790 - Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
K. ASTM D 1308 - Effect of Household Chemicals on Clear and Pigmented Organic Finishes.
L. ASTM D 1621 - Compressive Properties of Rigid Cellular Plastics.
M. ASTM D 1623 - Tensile and Tensile Adhesion Properties of Rigid Cellular Plastics.
N. ASTM D 2126 - Response of Rigid Cellular Plastics to Thermal and Humid Aging.
O. ASTM D 2583 - Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor.
P. ASTM D 3029 – Impact Resistance of Flat Rigid Plastic Specimens by Means of a Falling Weight.
Q. ASTM D 6670-01 - Standard Practice for Full-Scale Chamber Determination of Volatile Organic Emissions from Indoor Materials/Products.
R. ASTM E 84 - Surface Burning Characteristics of Building Materials.
S. ASTM E 90 - Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions.
T. ASTM E 283 - Determining the Rate of Air Leakage through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
U. ASTM E 330 - Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.
V. ASTM E 331 - Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference.
W. ASTM F 476 - Security of Swinging Door Assemblies.
X. ASTM F 1642-04 – Standard Test Method for Glazing Systems Subject to Air blast Loading.
Y. NWWDA T.M. 7-90 – Cycle Slam Test Method.
Z. SFBC PA 201 - Impact Test Procedures.
AA. SFBC PA 203 - Criteria for Testing Products Subject to Cyclic Wind Pressure Loading.
AB. SFBC 3603.2 (b)(5) - Forced Entry Resistance Test

1.03 SUBMITTALS

A. Submit in accordance with Section 01 33 00 - SUBMITTALS.

B. Product Data: Submit manufacturer's product data, including description of materials, components, fabrication, finishes, and installation.

C. Shop Drawings: Submit manufacturer's shop drawings, including elevations, sections, and details, indicating dimensions, tolerances, materials, fabrication, doors, panels, framing, hardware schedule, and finish.

D. Samples:
1. Door: Submit manufacturer's sample of door showing face sheets, core, framing, and finish.
2. Color: Submit manufacturer's samples of standard colors of doors and frames.

E. Test Reports: Submit test reports from qualified independent testing agency indicating doors comply with specified performance requirements.

F. Manufacturer's Project References: Submit list of successfully completed projects including project name and location, name of architect, and type and quantity of doors manufactured.

G. Maintenance Manual: Submit manufacturer's maintenance and cleaning instructions for doors, including maintenance and operating instructions for hardware.

H. Warranty: Submit manufacturer's standard warranty.

1.04 QUALITY ASSURANCE

A. Manufacturer's Qualifications:
1. Continuously engaged in manufacturing of doors of similar type to that specified.
2. Door and frame components from same manufacturer.
3. Evidence of a compliant documented quality management system.

1.05 DELIVERY, STORAGE AND HANDLING

A. Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying opening door mark and manufacturer.

B. Storage: Store materials in clean, dry area indoors in accordance with manufacturer's instructions.

C. Handling: Protect materials and finish from damage during handling and installation.

1.06 PROJECT WARRANTY

A. Warrant doors, frames, and factory hardware against failure in materials and workmanship, including excessive deflection, faulty operation, defects in hardware installation, and deterioration of finish or construction in excess of normal weathering.

B. Warranty Period: Ten years starting on date of shipment. In addition, a limited lifetime (while the door is in its specified application in its original installation) warranty covering: failure of corner joinery, core deterioration, delamination or bubbling of door skin.

1.07 SYSTEM PERFORMANCE

A. General: Provide door assemblies that have been designed and fabricated to comply with specified performance requirements, as demonstrated by testing manufacturer's corresponding standard systems.

B. Air Infiltration: For a single door 3'-0" x 7'-0", test specimen shall be tested in accordance with ASTM E 283 at pressure differential of 6.27 psf. Door shall not exceed 0.58 cfm/ft^2.

C. Water Resistance: For a single door 3'-0" x 7'-0", test specimen shall be tested in accordance with ASTM E 331 at pressure differential of 7.50 psf. Door shall not have water leakage.

D. Indoor air quality testing per ASTM D 6670-01: GREENGUARD Environmental Institute Certified including GREENGUARD for Children and Schools Certification.

E. Hurricane Test Standards, Single Door:
1. Uniform Static Load, ASTM E 330: Plus or minus 195 pounds per square foot.
2. Forced Entry Test, 300 Pound Load Applied, SFBC 3603.2 (b)(5): Passed.
3. Cyclic Load Test, SFBC PA 203: Plus or minus 53 pounds per square foot.
4. Large Missile Impact Test, SFBC PA 201: Passed.

F. Blast Test, Doors and Frames, ASTM F 1642-04, 6 psi / 41 psi-msec: Minimal Hazard.

G. Swinging Door Cycle Test, Doors and Frames, ANSI A250.4: Minimum of 25,000,000 cycles.

H. Cycle Slam Test Method, NWWDA T.M. 7-90: Minimum 5,000,000 Cycles.

I. Swinging Security Door Assembly, Doors and Frames, ASTM F 476: Grade 40.

J. Salt Spray, Exterior Doors and Frames, ASTM B 117: Minimum of 500 hours.

K. Sound Transmission, Exterior Doors, STC, ASTM E 90: Minimum of 26.

L. Thermal Transmission, Exterior Doors, U-Value, AAMA 1503-98: Maximum of 0.29 BTU/hr x sf x degrees F. Minimum of 55 CRF value.

M. Surface Burning Characteristics, FRP Doors and Panels, ASTM E 84:
1. Flame Spread: Maximum of 200, Class C.
2. Smoke Developed: Maximum of 450, Class C.

N. Impact Strength, FRP Doors and Panels, Nominal Value, ASTM D 256: 14.0 foot-pounds per inch of notch.

O. Tensile Strength, FRP Doors and Panels, Nominal Value, ASTM D 638: 12,000 psi.

P. Flexural Strength, FRP Doors and Panels, Nominal Value, ASTM D 790: 21,000 psi.

Q. Water Absorption, FRP Doors and Panels, Nominal Value, ASTM D 570: 0.20 percent after 24 hours.

R. Indentation Hardness, FRP Doors and Panels, Nominal Value, ASTM D 2583: 55.

S. Gardner Impact Strength, FRP Doors and Panels, Nominal Value, ASTM D 5420: 120 in-lb.

T. Abrasion Resistance, Face Sheet, Taber Abrasion Test, 25 Cycles at 1,000 Gram Weight with CS-17 Wheel: Maximum of 0.029 average weight loss percentage.

U. Stain Resistance, ASTM D 1308: Face sheet unaffected after exposure to red cabbage, tea, and tomato acid. Stain removed easily with mild abrasive or FRP cleaner when exposed to crayon and crankcase oil.

V. Chemical Resistance, ASTM D 543. Excellent rating.
1. Acetic acid, Concentrated.
2. Ammonium Hydroxide, Concentrated.
3. Citric Acid, 10%.
4. Formaldehyde.
5. Hydrochloric Acid, 10%.
6. Sodium hypochlorite, 4 to 6 percent solution.

W. Compressive Strength, Foam Core, Nominal Value, ASTM D 1621: 79.9 psi.

X. Compressive Modulus, Foam Core, Nominal Value, ASTM D 1621: 370 psi.

Y. Tensile Adhesion, Foam Core, Nominal Value, ASTM D 1623: 45.3 psi.

Z. Thermal and Humid Aging, Foam Core, Nominal Value, 158 Degrees F and 100 Percent Humidity for 14 Days, ASTM D 2126: Minus 5.14 percent volume change.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Manufacturer: Special-Lite, Inc., 860 S. Williams Street, Decatur, MI 49045; CDS Commercial Door Systems, 320 Camer Drive, Bensalem, PA 19020, Vale Doors, 409 MacDade Blvd, Collingdale, PA 19023, or approved equal.

2.02 FRP FLUSH DOORS

A. Construction:
   1. Door Thickness: 1-3/4 inches.
   2. Stiles and Rails: Aluminum extrusions made from prime-equivalent billet that is produced from 100% reprocessed 6063-T6 alloy recovered from industrial processes, minimum of 2-5/16-inch depth.
   3. Corners: Mitered.
   4. Provide joinery of 3/8-inch diameter full-width tie rods through extruded splines top and bottom integral to standard tubular shaped stiles and rails reinforced to accept hardware as specified.
   5. Securing Internal Door Extrusions: 3/16-inch angle blocks and locking hex nuts for joinery. Welds, glue, or other methods are not acceptable.
   6. Furnish extruded stiles and rails with integral reglets to accept face sheets. Lock face sheets into place to permit flush appearance.
   7. Rail caps or other face sheet capture methods are not acceptable.
   8. Extrude top and bottom rail legs for interlocking continuous weather bar.
   9. Meeting Stiles: Pile brush weatherseals. Extrude meeting stile to include integral pocket to accept pile brush weatherseals.
   10. Bottom of Door: Install bottom weather bar with nylon brush weatherstripping into extruded interlocking edge of bottom rail.
   11. Glue: Use of glue to bond sheet to core or extrusions is not acceptable.

B. Face Sheet:
   1. Material: FRP, 0.120-inch thickness, finish color throughout.
   2. Protective coating: Abuse-resistant engineered surface. Provide FRP with protective coating.
   3. Texture: Pebble.
   4. Color: To match color of insulated metal wall panels. Coordinate with wall panel manufacturer.
   5. Adhesion: The use of glue to bond face sheet to foam core is prohibited.

C. Core:
1. Material: Poured-in-place polyurethane foam.
2. Density: Minimum of 5 pounds per cubic foot.
3. R-Value: Minimum of 9.
4. ASTM E84: Class A.

D. Cutouts:
1. Manufacture doors with cutouts for required vision lites, louvers, and panels.
2. Factory install vision lites, louvers, and panels.

E. Hardware: See Section 08 71 00.

2.03 MATERIALS

A. Aluminum Members:
1. Aluminum extrusions made from prime-equivalent billet that is produced from 100% reprocessed 6063-T6 alloy recovered from industrial processes: ASTM B 221.
2. Sheet and Plate: ASTM B 209.
3. Alloy and Temper: As required by manufacturer for strength, corrosion resistance, application of required finish, and control of color.

B. Components: Door and frame components from same manufacturer.

C. Fasteners:
1. Material: Aluminum, 18-8 stainless steel, or other noncorrosive metal.
2. Compatibility: Compatible with items to be fastened.
3. Exposed Fasteners: Screws with finish matching items to be fastened.

2.04 FABRICATION

A. Sizes and Profiles: Required sizes for door and frame units, and profile requirements shall be as indicated on the Drawings.

B. Coordination of Fabrication: Field measure before fabrication and show recorded measurements on shop drawings.

C. Assembly:
1. Complete cutting, fitting, forming, drilling, and grinding of metal before assembly.
2. Remove burrs from cut edges.

D. Welding: Welding of doors or frames is not acceptable.

E. Fit:
   1. Maintain continuity of line and accurate relation of planes and angles.
   2. Secure attachments and support at mechanical joints with hairline fit at contacting members.

2.05 ALUMINUM DOOR FRAMING SYSTEM

A. Tubular Framing:
   1. Size and Type: As indicated on the Drawings.
   2. Materials: Aluminum extrusions made from prime-equivalent billet that is produced from 100% reprocessed 6063-T6 alloy recovered from industrial processes, 1/8-inch minimum wall thickness.
   3. Applied Door Stops: 0.625-inch high, with screws and weatherstripping. Door stop shall incorporate pressure gasketing for weathering seal. Counterpunch fastener holes in door stop to preserve full metal thickness under fastener head.
   4. Frame Members: Box type with 4 enclosed sides. Open-back framing is not acceptable.
   5. Caulking: Caulk joints before assembling frame members.
   6. Joints:
      a. Secure joints with fasteners.
      b. Provide hairline butt joint appearance.
   7. Field Fabrication: Field fabrication of framing using stick material is not acceptable.
   8. Applied Stops: For side, transom, and borrowed lites and panels. Applied stops shall incorporate pressure gasketing for weathering seal. Reinforce with solid bar stock fill for frame hardware attachments.
   9. Hardware:
      a. Premachine and reinforce frame members for hardware in accordance with manufacturer's standards and hardware schedule.
      b. Factory install hardware.
   10. Anchors:
      a. Anchors appropriate for wall conditions to anchor framing to wall materials.
      b. Door Jamb and Header Mounting Holes: Maximum of 24-inch centers.
      c. Secure head and sill members of transom, side lites, and similar conditions.
   11. Side Lites:
      a. Factory preassemble side lites to greatest extent possible.
      b. Mark frame assemblies according to location.

2.06 HARDWARE

A. Premachine doors in accordance with templates from specified hardware manufacturers and hardware schedule.

B. Factory install hardware.

B. Hardware Schedule: See Section 08 71 00.

2.07 VISION LITES

A. Factory Glazing: 1-inch glass insulating units.

B. Lites in Exterior Doors: Allow for thermal expansion.

C. Rectangular Lites: As indicated on Drawings.

2.08 ALUMINUM FINISHES

A. Painted: Color to match adjacent metal wall panel.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine areas to receive doors. Notify Architect of conditions that would adversely affect installation or subsequent use. Do not proceed with installation until unsatisfactory conditions are corrected.

3.02 PREPARATION

A. Ensure openings to receive frames are plumb, level, square, and in tolerance.

3.03 INSTALLATION

A. Install doors in accordance with manufacturer's instructions.

B. Install doors plumb, level, square, true to line, and without warp or rack.

C. Anchor frames securely in place.

D. Separate aluminum from other metal surfaces with bituminous coatings or other means approved by Architect.

E. Set thresholds in bed of mastic and backseal.

F. Install exterior doors to be weathertight in closed position.

G. Repair minor damages to finish in accordance with manufacturer's instructions and as approved by Architect.

H. Remove and replace damaged components that cannot be successfully repaired as determined by Architect.

3.04 FIELD QUALITY CONTROL

A. Manufacturer's Field Services: Manufacturer's representative shall provide technical assistance and guidance for installation of doors.

3.05 ADJUSTING

A. Adjust doors, hinges, and locksets for smooth operation without binding.

3.06 CLEANING

A. Clean doors promptly after installation in accordance with manufacturer's instructions.

B. Do not use harsh cleaning materials or methods that would damage finish.

3.07 PROTECTION

A. Protect installed doors to ensure that, except for normal weathering, doors will be without damage or deterioration at time of substantial completion.

END OF SECTION

Section 08 54 13
FIBERGLASS WINDOWS

PART 1 GENERAL

1.01 DESCRIPTION

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 1 – GENERAL REQUIREMENTS, which are hereby made a part of this Section of the Specifications.

B. This section specifies fiberglass double hung and fixed windows.

1.02 RELATED WORK

A. Section 06 10 00 – ROUGH CARPENTRY.

B. Section 07 27 26, AIR BARRIER.

C. Section 07 42 00 - METAL INSULATED PANELS.

D. Section 07 90 00 – SEALANTS AND CAULKING.

E. Section 13 34 19, PRE-ENGINEERED BUILDING.

1.03 SUBMITTALS

A. Submit in accordance with Section 01 30 00, SUBMITTALS.

B. Product Data:
1. Submit manufacturer's product data, including installation instructions.

C. Shop Drawings: Submit for approval the following:
1. Elevation for each style window specified; indicate sizes, glazing types, muntin types and designs.
2. Schedule: Indicate each window in the project; reference each unit to a specific elevation style.
3. Details: Head, jamb, and sill details for each project condition.

D. Selection Samples: Manufacturer's full range of available colors.

E. Verification Samples: Operating units of each style window specified; verification samples may be operating scaled-down mock-ups of actual-size units. Verification samples will be returned to manufacturer's representative at project closeout.

F. Quality Assurance Submittals: Evidence of certifications of window units required in QUALITY ASSURANCE Article of this section.

1.04 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification. The publications are referenced in the text by the basic designation only.

B. American Architectural Manufacturers Association/Window and Door Manufacturers Association/Canadian Standard Association (AAMA/WDMA/CSA):
1. AAMA/WDMA/CSA 101/I.S.2/A440-05: Standard/Specification for Windows, Doors, and Unit Skylights.
2. AAMA/WDMA/CSA 101/I.S.2/A440-08: Standard/Specification for Windows, Doors, and Unit Skylights.

C. American Society for Testing and Materials (ASTM):
1. E 283: Standard Test Method of Air Leakage Through Exterior Windows, Curtain Walls and Doors.
2. E 330: Standard Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.
3. E 547: Standard Test Method for Water Penetration of Exterior Windows, Curtain Walls, and Doors by Cyclic Static Air Pressure Differential.
4. E 2190: Standard Specification for Insulating Glass Unit Performance and Evaluation.
5. C 1036: Standard Specification for Flat Glass.
6. E 90-09: Standard Test Method for laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
7. F 2090-10: Standard Specification for Window Fall Prevention Devices with Emergency Escape (Egress) Release Mechanisms.

D. Screen Manufacturers Association (SMA):
1. SMA 1201 – Specifications for Insect Screens for Windows, Sliding Doors and Swinging Doors.

E. Insulating Glass Manufactures Alliance / Insulating Glass Certification Council (IGMA/IGCC).

F. Window and Door Manufactures Association (WDMA): HALLMARK Certification Programs.

G. American Architectural Manufactures Association (AAMA): 623-10: Voluntary Specification, Performance Requirements and Test Procedures for Organic Coatings on Fiber Reinforced Thermoset Profiles.

H. National Fenestration Rating Council (NFRC): 101: Procedure for Determining Fenestration Product Thermal Properties.

1.04 PERFORMANCE REQUIREMENTS

A. Design and Performance Requirements:
1. Windows units shall be designed to comply with AAMA/WDMA/CSA 101/I.S.2/A440-05 and AAMA/WDMA/CSA 101/I.S.2/A440-08.
a. Awning: -05 (LC-PG40).
b. Fixed: -05 (FW-C50).

2. Air leakage shall not exceed the following when tested at 1.57 according to ASTM E 283: 0.3 cfm per square foot of frame.

3. No water penetration shall occur when units are tested at the following pressure according to ASTM E 547:
a. Awning: LC-PG40 - 7.5 psf.
b. Fixed: FW-C50 - 7.5 psf.

4. Units shall be designed to comply with ASTM E 330 for structural performance when tested at the following pressures:
a. Awning: LC-PG40 - 75 psf.
b. Fixed: FW-C50 - 75 psf.

1.05 QUALITY ASSURANCE

A. Qualifications:
1. Manufacturer: Minimum three years documented experience producing products specified in this section.
2. Installer: Minimum three years documented experience installing products specified in this section.

B. Mockup:
1. Provide sample installation for field testing window performance requirements and to determine acceptability of window installation methods.
2. Approved mock-up shall represent minimum quality required for the Work.
3. Approved mock-up shall remain in place within the Work.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Deliver materials to site undamaged in manufacturer’s or sales branch’s original, unopened containers and packaging, with labels clearly identifying manufacturer and product name. Include installation instructions.

B. Storage: Store materials off ground, under cover, and protected from weather, direct sunlight, and construction activities.

C. Handling: Protect materials and finish during handling and installation to prevent damage.

1.07 WARRANTY

A. Windows are subject to terms of Article 11 – Guarantees and Warranties of the GENERAL CONDITIONS, except the manufacturer shall furnish the following:
1. 10 year product warranty.
2. 20 year glass warranty.
3. 2 year labor.
4. Fully transferable and non pro-rated.

PART 2 PRODUCTS

2.01 MANUFACTURER

A. Acceptable Manufactured Units:
1. Ultrex® as manufactured by Integrity Windows and Doors from Marvin, 1320 9th Street Northeast, West Fargo ND 58078, (701) 499-3700.
2. Inline Fiberglass Ltd., 30 Constellation Court, Toronto, Ontario, Canada M9W1K1.
3. Accurate Dorwin, 1535 Steel Avenue, Winnepeg, Manitoba, Canada R3T1C6.
4. Fibertec Windows, 280 Bowes Road, Concord, Ontario, Canada L4K1J9.
5. Armaclad Windows & Doors, 4422 West 46th Street, Chicago, IL 60632.

2.02 FRAME DESCRIPTION

A. Interior: AAMA 101, pultruded reinforced fiberglass, 0.70 inch thick.

B. Frame width: 3-3/32 inches.

C. Jamb depth: 2 inches.

2.03 SASH DESCRIPTION

A. Pultruded reinforced fiberglass, 0.077 inch thick.

B. Composite sash thickness: 15/16 inches.

2.04 GLAZING

A. Select quality complying with ASTM C 1036. Insulating glass SIGMA/IGCC certified to performance level CBA when tested in accordance with ASTM E 2190. STC ratings are certified to the level in accordance with ASTM E 90-09.

B. Glazing method: 11/16 inch insulated glass.

C. Glass type: Low E with air gas.

D. Glazing seal: Silicone bedding at exterior and a glazing boot to interior.

2.05 FINISH

A. Exterior: Pultruded fiberglass. Factory baked on acrylic urethane. Meets AAMA 623-10 requirements.

B. Interior: Pultruded fiberglass. Factory baked on acrylic urethane. Meets AAMA 623-10 and 00022716 requirements.

C. Color: To be selected from manufacturer's standard colors.

2.06 HARDWARE

A. Lock: Multipoint locking mechanism is actuated from a single point of operation. The lock mechanism is concealed with only the actuator handle and escutcheon being visible to the interior.

B. Hinges: Concealed stainless steel track and injection molded shoe.

C. Handle: Die cast detachable folding handle.

D. Roto-gear Operator: E-Gard™ coated hinge arm and housing mechanism.

E. Snubber: Pulls the sash tight to the frame and provides engagement to keep the sash in place under structural loads.

2.07 WEATHERSTRIP

A. Primary weather strip is an extruded TPE foam filled bulb attached to all four sides of the frame by a kerf and provides seal between sash and frame.

B. Secondary weather strip is an extruded TPE hollow bulb that attaches to a kerf in the sash and provides seal between sash and frame.

C. Standard weather strip color: black

2.08 JAMB EXTENSION

A. Standard: Jamb is 2"; factory installed 4-9/16" or 6-9/16".

2.09 INSECT SCREEN

A. Factory installed screen. 18 by 16 Charcoal fiberglass. Half screen at Double Hung windows and full screen at Awning/Casement windows.

B. Rolled formed aluminum frame. Color to be white.

2.10 ACCESSORIES AND TRIM

A. Factory installed vinyl folding nailing fin at head, sill and side jambs.

B. Sheet rock return.

C. Mullion kit: Standard mullion kit for field assembly of related units.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine areas to receive new windows. Notify Engineer immediately of conditions that would adversely affect installation or subsequent use. Do not proceed with installation until unsatisfactory conditions are corrected.

3.02 INSTALLATION

A. Install windows in accordance with manufacturer's instructions.

B. Install windows to be weather-tight and freely operating.

C. Maintain alignment with adjacent work.

D. Secure assembly to framed openings, plumb and square, without distortion.

E. Place interior seal around window perimeter to maintain continuity of building thermal and air barrier using insulating foam sealant.

F. Seal window to exterior wall cladding with sealant and related backing materials at perimeter of assembly.

G. Leave windows closed and locked.

3.03 FIELD QUALITY CONTROL

A. Field Testing: Field-test windows in accordance with AAMA 502, Test Method.

3.04 CLEANING

A. Clean window frames and glass in accordance with Division 1 requirements.

B. Do not use harsh cleaning materials or methods that would damage finish.

C. Remove labels and visible markings.

3.05 PROTECTION

A. Protect installed windows to ensure that, except for normal weathering, windows will be without damage or deterioration at time of substantial completion.

3.06 WINDOW SCHEDULE

A. See drawings for schedule and sizes.

END OF SECTION

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SECTION 08 56 19

INTERIOR SLIDING PASS WINDOW

PART 1 - GENERAL

1.01 SUMMARY

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 1 – GENERAL REQUIREMENTS, which are hereby made a part of this Section of the Specifications.

B. Frameless interior pass-thru sliding service windows as indicated in Drawings.

1.02 RELATED SECTIONS

A. Section 06 61 00, SOLID POLYMER FABRICATIONS.

B. Section 08 81 00, GLASS AND GLAZING.

C. Section 09 21 16, GYPSUM BOARD SYSTEM.

1.03 SUBMITTALS

A. Submit in accordance with Section 01 33 00, SUBMITTALS.

B. Shop Drawings: Submit for fabrication and installation of windows. Include details, elevations and installation requirement of finish hardware and cleaning.

C. Product Data: Submit Manufacturer’s technical product data substantiating that products comply, and installation instructions.

D. Samples: Exposed finishes. 4” piece of each color.

1.04 DELIVERY, STORAGE AND HANDLING

A. Deliver windows crated to provide protection during transit and job storage.

B. Inspect windows upon delivery for damage. Damaged parts should be removed and replaced.

C. Store windows at building site under cover in dry location.

D. Protect products from damage during handling and construction operations.

1.05 WARRANTY

A. Warranty: All material and workmanship shall be warranted against defects for a period of one (1) year from Substantial Completion.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Header: Shall be constructed of 6063-T5 extruded aluminum. Window rolls on top-hung ball bearing rollers. Overall size is to be in accordance with the contract drawings.

B. Finish: All aluminum to be brite anodized.

C. Glazing: The glazing is to be ¼" in thickness.

D. Options: Push button lock.

2.02 PRODUCTS GENERAL

A. Basis of design: Design is based on Sharyn Series Frameless Interior Pass-Thru Window manufactured by C.R. Laurence Co., Inc, or approved equal.

2.03 PASS WINDOWS

A. Pass Window Units: Factory fabricated, glazed unit; horizontal sliding type.
   1. Header: Extruded aluminum.
   2. Glass: Safety type specified in Section 08 81 00, GLASS AND GLAZING.
   3. Hardware: Manufacturer's standard double track header, rollers, guides, push button lock.

PART 3 - EXECUTION

3.01 PREPARATION

A. Examine and verify substrate suitability for product installation.

B. Verify rough opening is properly sized and located.

C. Protect existing construction and completed work from damage.

D. Apply barrier coating to aluminum surfaces in contact with dissimilar metals and cementitious materials to minimum 0.7 mm (30 mils) dry film thickness.

3.02 INSTALLATION

A. Install window in accordance with manufacturer's printed instructions and recommendations. Repair damaged units as directed (if approved by the manufacturer and the Architect) or replace with new units.

3.03 CLEANING

A. Clean frame and glazing surfaces after installation, complying with requirements contained in the manufacturer's instructions. Remove excess glazing sealant compounds, dirt or other substances.

3.04 PROTECTION

A. Institute protective measures required throughout the remainder of the construction period to ensure that all the windows do not incur any damage or deterioration, other than normal weathering, at the time of acceptance.

END OF SECTION

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SECTION 08 71 00

HARDWARE

PART 1 GENERAL

1.01 DESCRIPTION

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 1 – GENERAL REQUIREMENTS, which are hereby made a part of this Section of the Specifications.

B. Builders hardware and related items necessary for completed installation and operation of doors on new and existing construction.

1.02 RELATED WORK

A. Section 07 90 00, SEALANTS AND CAULKING.

B. Section 08 11 00 - STEEL DOORS AND FRAMES.

C. Section 08 40 00 - FIBERGLASS REINFORCED PANEL (FRP) DOORS.

D. Section 09 90 00, PAINTING.

1.03 GENERAL

A. Hardware for Labeled Fire Doors and Exit Doors: Hardware shall conform to requirements of NFPA 80 for labeled fire doors and to NFPA 101 for exit doors, as well as to other requirements specified. Labeling and listing by UL Building Materials Directory, for class of door being used will be accepted as evidence of conformance to these requirements. Install minimum latch throw as specified on label of individual door. Provide hardware listed by UL, except where heavier materials, larger sized, or better grades are specified herein under paragraph HARDWARE SETS. In lieu of UL labeling and listing, test reports from a nationally recognized testing agency may be submitted showing that hardware has been tested in accordance with UL test methods and that it conforms to NFPA requirements.

B. Hardware for application on metal doors and frames shall be made to standard templates. Templates shall be furnished to the fabricator of these items in sufficient time so as not to delay the construction.

C. The following items shall be of the same manufacturer, except as otherwise specified:
1. Butts
2. Continuous Geared Hinge
3. Closer
4. Lockset
5. Door stops
6. Kick plates
7. Silencers
8. Flush bolts.
9. Exit device.

1.04 SUBMITTALS

A. Submit in accordance with Section 01 33 00, SUBMITTALS.

B. Schedules: Submit vertical hardware schedules after the hardware sample list is approved. Horizontal hardware schedules are not acceptable. Contractor is responsible for coordinating and verifying schedules. Schedules shall show quantities, manufacturer's catalog number and federal specifications, types and location (height above finished floor) of all items of builders hardware required for project. One copy of the schedule shall be sent to Project Director at address specified above for his records.

E. Certificate of Compliance and Test Reports: Submit certificates certifying that hardware conforms to the requirements specified herein. Certificates shall be accompanied by certified copies of reports as referenced in the applicable specification. Submit acceptable Certificates and Test Reports prior to installation of hardware on the project. The testing shall have been conducted either in the manufacturer's plant and certified by an independent testing laboratory or conducted in an independent laboratory, within four years of submittal of reports for approval.

1.05 DELIVERY AND MARKING

A. Deliver items of hardware to job site in their original individual containers, complete with necessary appurtenances including screws, keys, and instructions. Contractor shall select and tag one of each different item of hardware and deliver to Architect for reference purposes. Tag shall identify item by Project Specification type or number and manufacturer's catalog number. These items shall remain on file in Architect's office until all other similar items have been installed in project, at which time he will deliver items on file to Contractor for installation in predetermined locations on project.

1.06 INSTRUCTIONS

A. Hardware Set Symbols on Drawings: Except for protective plates, door stops, mutes, thresholds and the like specified herein, hardware requirements for each door are indicated on drawings by symbols. Symbols for hardware sets consist of letters "HW" followed by a number. These numbers each designate a set of hardware items which are listed under a corresponding number in Hardware Sets which form a part of these specifications.

B. Manufacturers' Catalog Number References: Where manufacturers' products are specified herein, products of other manufacturers which are considered equivalent to those specified, may be used.

C. Keying: All cylinders shall be keyed into existing Master Key System.

1.07 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification. The publications are referenced in the text by the basic designation only. In text, hardware items are referred to by series, types, etc., listed in such specifications and standards, except as otherwise specified.

B. American National Standards Institute, Inc. (ANSI):
A156.1.....Butts and Hinges
A156.2.....Bored and Preassembled Locks and Latches
A156.4.....Door Controls (Closers)
A156.5.....Auxiliary Locks and Associated Products
A156.6.....Architectural Door Trim
A156.8.....Door Controls-Overhead Holders
A156.13.....Mortise Locks and Latches
A156.15.....Closer Holder Release Devices
A156.16.....Auxiliary Hardware
A115.....Specifications for Door and Frame Preparation

C. Builders Hardware Manufacturers Association (BHMA):
1301.....Materials and Finishes

D. National Fire Protection Association (NFPA):
80.....Standard for Fire Doors and Windows
101.....Life Safety Code

E. Underwriters Laboratories, Inc. (UL):
Building Materials Directory

F. Americans with Disabilities Act (ADA): Guidelines.

G. Massachusetts Architectural Access Barrier Regulations - 521 CMR (MAAB)

PART 2 PRODUCTS

2.01 BUTT HINGES

A. ANSI A156.1. The following types of butt hinges shall be used for the types of doors listed, except where otherwise specified.
   1. Interior Doors: ANSI A8111 (heavy weight ball bearing) for doors 3'-6" wide or less. Hinges for interior doors shall have non-removable pins. Hager BB1168 (US26D) or approved equal.

2.02 CONTINUOUS GEAR HINGE

A. Continuous geared hinge shall conform to the following.
   1. Full mortised continuous geared hinge manufactured of 6063-T6 anodized aluminum and non-handed.
   2. Hinge shall be manufactured of three interlocking components, two hinge leaves and one cover channel. The door leaf and jamb leaf shall be geared together for the entire length of the hinge, and joined by a cover channel. The pinless assembly of the three interlocking extrusions shall be applied to the full height of the door and frame without mortising.
   3. All unexposed working metal surfaces shall be coated with TFE dry lubricant.
   4. Vertical door loads shall be carried on 32 bearings (heavy duty) through a full 180 degree opening. Bearings to be completely concealed in the cover channel. Hinges with visible knuckles separation are not acceptable.
   5. Hinge cover channel is to be monolithic in appearance and withstand 7000 foot pounds of pull apart pressure.
   6. Six screw holes shall be concentrated at each end of the hinge and additional screws are proportionally spaced along the full length of the hinge. Self-drilling, hardened and plated steel fasteners 12-24 x 11/16 inch, flat head undercut, Phillips head screws are to be furnished.
   7. All aluminum components are to be anodized in accordance with HC-II (AA-M12C22A44) aluminum mill finish.
   8. Hinge shall be length appropriate for the door.
   9. Manufacture: "Roton" hinge model no. 780-111 HD by Hager or approved equal.

2.04 OVERHEAD CLOSERS

A. ANSI A156.4, Grade 1.

B. Closers shall conform to the following:

1. The closer shall have 50 percent adjustable closing force over minimum value for that closer and have adjustable hydraulic back check effective between 60 degrees and 85 degrees of door opening.
2. Where specified, closer shall have hold open feature.
3. Size Requirements: Closer size shall be 2 through 6. No multi-sized closers will be accepted.
4. Material of closer shall be forged or cast iron.
5. Arm and brackets for closers shall be steel, malleable iron or high strength ductile cast iron.
6. Closers shall have full size cover.
7. Closers shall have adjustable hydraulic back-check and separate valves for closing and latching speed. Closer shall be adjusted to a maximum 5 pound applied opening force.
8. Finish: Manufacturer's standard powder coated finish aluminum (BHMA 689).
9. Manufacturer: LCN Closers 4011 Series or approved equal, aluminum finish.

2.05 EXIT DEVICE

A. Vertical Rod Fire Exit Device: UL listed for panic exit hardware. Device shall be ANSI A156.3-2001 Grade 1. Center case dimensions are 8-3/16 inches x 1-9/16 inches x 2-13/32 inches. Outside shall have lever with blank escutcheon - always operable. Manufacturer: Von Duprin Series AX-3527A-L-BE-06-F-3'-US26D.

2.06 LOCKS AND LATCHES

A. Lock cylinders: ANSI A156.2. Locks and latches for doors 1-3/4 inch thick or over shall have beveled fronts. Lock cylinders shall be Medeco KeyMark provided by Owner. Cylinders for all locksets shall be removable core type. Cylinder shall be removable by special key or tool. Construct all cores so that they will be instantly interchangeable into the core housings of all mortise locks, rim locks, cylindrical locks, and any other type lock included in the Master Key System. Disassembly of lever or lockset shall not be required to remove core from lockset. **Note: Contractor shall coordinate cylinder requirements with Owner prior to submitting lock sets and latch sets**.

B. Heavy Duty Cylindrical Lever Latchset: Cylindrical locksets shall be series ANSI Grade 1. Strikes for all mortise locks and latches (including deadlocks) shall conform to ANSI A156.2. All locksets and latchsets shall have lever handles similar to Schlage "Rhodes" design. Lever handle shall be fabricated from die cast zinc. No substitute lever design or material will be accepted. All locks and latchsets shall be furnished with curved lip strike and wrought box. Manufacturer: Schlage ND-Series "Rhodes" design, finish US26D or approved equal. Lever functions shall be F75 (passage), F86 (storage), F76 (privacy), F82 (office) or as specified.

C. Mortise Lock Sets:
1. Mortise locksets shall be ANSI Grade 1. Strikes for all mortise locks and latches (including deadlocks) shall conform to ANSI A115.1. All locksets shall have lever handles similar to Schlage "D-Rhodes" design. Lever handle shall be fabricated from cast stainless steel and escutcheon to be wrought. No substitute lever design or material will be accepted. All locks and latchsets shall be furnished with curved lip strike and wrought box.
   a. Manufacturer: Schlage L-Series, "D Rhodes" design, specified finish US26D or approved equal. Lever function F01 (passage), F04 (office), F07 (storeroom), F20 (entrance), F22 (privacy).

2.07 KEYS

A. Stamp all keys with change number and key set symbol. Furnish keys in quantities as follows:

Cylinder locks	**10 keys for each door**
Cylinder lock change key	
Blanks	10 each different key way
Master-keyed sets	6 keys each
Control key	1 key

2.08 DOOR STOPS

A. ANSI A156.16.

B. Provide door stops wherever an opened door or any item of hardware thereon would strike a wall, column, equipment or other parts of building construction. For concrete, masonry or quarry tile construction, use lead expansion shields for mounting door stops.

C. Where partitions occur, use wall stops, ANSI A156.16, Type L02251. Hager model no. 234W (US26D) or approved equal.

D. Substitute floor stops, ANSI A156.16, Type L02161 as appropriate, when wall bumpers would not provide an effective door stop. Hager model no. 243F (US26D) or approved equal.

2.09 THRESHOLDS AND WEATHER STRIPPING

A. General: Extruded metal products made from 6063-T5 and 6463 Aluminum alloy with thermal break and finish as specified.

B. Exterior Metal Thresholds: ANSI A156, 4 except as otherwise specified. Thresholds shall be installed in a bed of sealant and per manufacturer's recommendations for specific application. For sealant see Section, SEALANTS. Install thresholds where shown on drawings. Nominal size 1/2" high x width required for door. Thresholds similar to model 451S-MIL as manufactured by Hager or approved equal.

C. Smoke/Fire Gasketing and Astragal: Effective between -58°F and +450°F. Meets FAR 25.853 Airworthiness Standard for Compartment interiors. Air infiltration tested in accordance with ASTM E-283-04, .09 CFM/ft of crack. Smoke tested in accordance with UBC7-2 and UL 1784-01; meets the requirements of NFPA 105 "Standard for the Installation of Smoke Door Assemblies and Other Opening Protectives". 891S MIL as manufactured by Hager, or approved equal.

D. Door Sweep: Smoke tested in accordance with UBC7-2 and UL 1784-01. Provide integral curved vinyl strips with extruded aluminum retainer 1” high. 781S MIL as manufactured by Hager, or approved equal.

2.10 KICK PLATES

A. ANSI Standard A156.6.

B. Provide protective plates as specified below:
1. Kick plates shall be metal .050" thickness.
2. Provide kick plates for both sides of each new door, except where noted as not required. Kick plates shall be 12 inches high. On push side of doors where jamb stop extends to floor, make combination kick plates 1-1/2 inches less than width of door, except pairs of metal doors which shall have plates 1-inch less than width of each door. Extend all other combination kick-mop plates to within 1/4-inch of each edge of doors. For jamb stop requirements, see specification sections pertaining to door frames.
3. Kick plates are required as specified.
4. Manufacturer: Ives, product no. 8400, finish B26D or approved equal.

2.11 FLUSH BOLTS

A. ANSI A156.16 for L04201.

B. Provide flush bolt on inactive leaf standard slide rod and strike plate. Hager model no. 281D (US26D) or approved equal.

2.12 SILENCER

A. Silencer: Provide gray rubber silencers that conforms to ANSI A156.16 L03011. Model similar to Hager 307D or approved equal.

2.13 FINISHES

A. Exposed surfaces of hardware shall have B.H.M.A. Standard 1301, finishes as specified below. Finishes on all hinges, pivots, closers, thresholds, etc., shall be as specified below under "Miscellaneous Finishes." For field painting (final coat) of ferrous hardware, see Section 09 90 00, PAINTING.

B. 626: All surfaces on buildings, except where other finishes are specified.

C. Miscellaneous Finishes:
1. Hinges (interior doors): 626 (US26D)
2. Hinges (exterior doors): 630 (US32D)
3. Mortise Locksets (interior doors): 626 (US26D)
4. Mortise Locksets (exterior doors): 630 (US32D)
5. Pivots: Match door trim.
6. Door Closers: Factory applied paint finish. Aluminum color.
7. Other hardware: 626 or 630 (US26D or US32D)

2.14 BASE METALS

A. Apply specified U.S. Standard finishes on following base metals:

Finish	Apply On
626	Steel
630	Brass or bronze
630	Stainless steel

PART 3 EXECUTION

3.01 HARDWARE HEIGHTS

A. All hardware mounting heights shall comply with the requirements of MAAB and ADA, no exceptions. Otherwise, locate hardware on doors at heights specified below.

B. Hardware Heights From Finished Floor.
1. Locksets and latch sets centerline of strike 40-5/16 inches.
2. Centerline of peep hole to be 48 inches.

C. Modifications, necessitated by reason of construction, shall be submitted to Architect for approval before being made.

3.02 INSTALLATION

A. Closer devices, including those with hold-open features, shall be equipped and mounted to provide maximum door opening permitted by building construction or equipment. Closers shall be mounted regular arm. Where closers are mounted on doors they shall be mounted with sex nuts and bolts; foot shall be fastened to frame with machine screws. Adjust closer speed to comply with MAAB.

B. Substitute parallel arm or top jamb mounting for regular arm mounting where the following conditions occur:
1. Where door swing, in full open position, would be limited to less than 90 degrees due to partition construction and closer location.

C. Hinge Size Requirements:

Thickness of Door	Width of Door	Height of Hinge
1-3/4 inch	3 feet and less	4-1/2 inches

D. Hinge leaves shall be sufficiently wide to allow doors to swing clear of door frame trim.

E. Hinges Required Per Door:
Doors over 5 feet high and not over 7 feet 6 inches high: 3 butts

F. Fastenings: Suitable size and type and shall harmonize with hardware as to material and finish. Provide machine screws and lead expansion shields to secure hardware to concrete, ceramic or quarry floor tile, or solid masonry. Fiber or rawl plugs and adhesives are not permitted. All fastenings exposed to weather shall be of nonferrous metal.

G. After locks have been installed; show in presence of Owner that keys operate their respective locks in accordance with keying requirements. Installation of locks which do not meet specified keying requirements shall be considered sufficient justification for rejection and replacement of all locks in stalled on project.

3.03 HARDWARE SETS

A. Following sets of hardware correspond to hardware symbols shown on drawings.

HARDWARE SETS

Item	Finish	Model No.

B. Hardware Set No. 1 (HW1):

Doors 101, 125, 127, 127, 128, 129, 130, 131:

1 Continuous Geared Hinge	Aluminum	780-111 HD
1 Mortise Lockset	US26D	L9453
1 Closer	BHMA 689	4011
1 Threshold	Aluminum	451S

Hardware Set No. 2 (HW2):
Doors 102, 103:

1 1/2 pr. Butts	US26D	BB1168
1 Closer	BHMA 689	4011
3 Silencers	Gray	307D
1 Cylindrical Lockset	US26D	ND50PD (F82)
2 Kickplates	US26D	8400
1 Door Stop	US26D	234W

Hardware Set No. 3 (HW3):
Doors 104, 117:

1 1/2 pr. Butts	US26D	BB1168
3 Silencers	Gray	307D
1 Cylindrical Lockset	US26D	ND50PD (F82)
2 Kickplates	US26D	8400

Hardware Set No. 4 (HW4):
Doors 105:

1 1/2 pr. Butts	US26D	BB1168
3 Silencers	Gray	307D
1 Cylindrical Lockset	US26D	ND10S (F75)
1 Door Stop	US26D	234W

Hardware Set No. 5 (HW5):
Doors 106, 118:

1 1/2 pr. Butts	US26D	BB1168
1 Closer	BHMA 689	4011
3 Silencers	Gray	307D
1 Cylindrical Lockset	US26D	ND40S (F76)
2 Kickplates	US26D	8400
1 Door Stop	US26D	234W

Hardware Set No. 6 (HW6):
Doors 107, 108, 109, 110, 113, 119, 123:

1 1/2 pr. Butts	US26D	BB1168
1 Closer	BHMA 689	4011
3 Silencers	Gray	307D
1 Cylindrical Lockset	US26D	ND10S (F75)
2 Kickplates	US26D	8400
1 Door Stop	US26D	234W

Hardware Set No. 7 (HW7):
Doors 111, 112, 114:

1 1/2 pr. Butts	US26D	BB1168
1 Closer	BHMA 689	4011
3 Silencers	Gray	307D
1 Cylindrical Lockset	US26D	ND80PD (F86)
2 Kickplates	US26D	8400

Hardware Set No. 8 (HW8):
Doors 115, 116:

3 pr. Butts	US26D	BB1168
6 Silencers	Gray	307D
1 Cylindrical Lockset	US26D	ND80PD (F86)
4 Kickplates	US26D	8400
2 Flush Bolt	US26D	281D

Hardware Set No. 9 (HW9):
Doors 120, M01:

3 pr. Butts	US26D	BB1168
2 Closer	BHMA 689	4011
6 Silencers	Gray	307D
1 Cylindrical Lockset	US26D	ND80PD (F86)
4 Kickplates	US26D	8400
2 Flush Bolt	US26D	281D
Smoke Gasket & Astragal	Mil/Gray	891S
2 Door Bottom	Mil/Gray	781S

Hardware Set No. 10 (HW10):
Doors 121, 122:

3 pr. Butts	US26D	BB1168
2 Closer	BHMA 689	4011
2 Vertical Rod Exit Device	US26D	AX-3527A
6 Silencers	Gray	307D
4 Kickplates	US26D	8400

Hardware Set No. 11 (HW11):
Doors M02:

1 1/2 pr. Butts	US26D	BB1168
1 Closer	BHMA 689	4011
3 Silencers	Gray	307D
1 Cylindrical Lockset	US26D	ND80PD (F86)
2 Kickplates	US26D	8400
Smoke Gasket	Mil/Gray	891S
1 Door Bottom	Mil/Gray	781S

END OF SECTION

SECTION 08 71 10

INSTALLATION OF DOORS AND HARDWARE

PART 1 GENERAL

1.01 DESCRIPTION

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 1 – GENERAL REQUIREMENTS, which are hereby made a part of this Section of the Specifications.

B. This section specifies the hanging of doors and installation of hardware.

1.02 RELATED WORK

A. Section 07 90 00, SEALANTS AND CAULKING.

B. Section 08 11 00, STEEL DOORS AND FRAMES.

C. Section 08 40 00, FIBERGLASS REINFORCED PANEL (FRP) DOORS AND FRAMES.

D. Section 08 71 00, HARDWARE.

1.03 APPLICABLE PUBLICATIONS

A. Publications listed below form a part of this specification. Publications are referenced in the text by the basic designation only.

B. American National Standards Institute and Door and Hardware Institute (ANSI/DHI): Installation Guide for Doors and Hardware (Latest Edition)

C. Americans with Disabilities Act (ADA): Guidelines.

D. Massachusetts Architectural Access Barrier Regulations - 521 CMR (MAAB)

PART 2 PRODUCTS

2.01 FASTENERS

A. Use fasteners furnished with hardware to be installed.

1. Where fasteners are not furnished with the item use fasteners of suitable size and type to harmonize with the item as to material and finish and to suit the material to which fastened.
2. Use machine screws and metal expansion shields to secure hardware to concrete, ceramic or quarry tile, or solid masonry. Do not use fiber, plastic, and lead plugs or adhesives.

PART 3 EXECUTION

3.01 INSTALLATION, GENERAL

A. Hang doors and install hardware when concrete work, plastering, tile setting, and other operations have been completed which increase humidity and dust in building.

B. Do not hang wood doors in areas where materials are not sufficiently dry so as to not affect the dimensional stability of the door.

C. Install hardware, except hinges, after field painting or sealing, specified in Section 09 90 00, PAINTING.

D. Center doors in the opening or frame with contact surfaces fit tight and even without forcing or warping the components.

E. Replace doors and frames that do not conform to hardware height requirements.

F. Install door hardware (mounting heights) to comply with requirements of 521 CMR (MAAB) and with recommendations of manufacturer.

3.02 INSTALLING DOORS AND BUILDER'S HARDWARE

A. Install hardware at the location (heights) specified.

B. Install in accordance with the manufacturer's printed instructions and ANSI/DHI Installation Guide for Doors and Hardware unless specified otherwise.

C. Drill and tap screw holes in steel frames and doors for surface mounted hardware.

D. Use shims only at hinges where required to provide uniform clearance and alignment of door. Cut shims from stainless steel sheet to same size as hinge.

E. Do not drive screws in place.

F. Carefully fit and securely attach hardware items to doors and frames.

3.03 CLEANING AND ADJUSTING

A. Adjust Doors, including hardware to operate as designed without binding or deformation of the members.

B. After installation, clean surfaces, remove temporary labels, paint spots and other defacement.

C. Clean prefinished and plated items and items fabricated from stainless steel, aluminum and copper alloys, as recommended by the manufacturer.

3.04 PROTECTION

A. Protect doors and hardware from damage until completion of the project.

END OF SECTION

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SECTION 08 81 00

GLASS AND GLAZING

PART 1 GENERAL

1.01 DESCRIPTION

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 1 – GENERAL REQUIREMENTS, which are hereby made a part of this Section of the Specifications.

B. This section specifies glass and related glazing materials and accessories. Glazing products specified apply to factory and field glazed items.

1.02 RELATED WORK

A. Section 08 11 00, STEEL DOORS AND FRAMES.

B. Section 08 56 19, INTERIOR SLIDING PASS WINDOW.

1.03 LABELS

A. Temporary labels:
1. Provide temporary label on each light of glass identifying manufacturer or brand and glass type, quality and nominal thickness.
2. Temporary labels shall remain intact until glass is approved by the Architect.

1.04 SUBMITTALS

A. Submit in accordance with Section 01 33 00, SUBMITTALS.

B. Manufacturer's Certificates:
1. Certificates stating that glass meets requirements for safety.

C. Manufacturer's Literature and Data:
1. Glass, each kind required.
2. Glazing cushion.
3. Sealing compound.

1.05 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification. The publications are referenced in the text by the basic designation only.

B. American Society for Testing and Materials (ASTM):
C236.....Steady State Thermal Performance of Building Assemblies, by Means of A Guarded Hot Box.
C542-82(1984).....Lock-Strip Gaskets
C669-75(1989).....Glazing Compounds for Back Bedding and Face Glazing of Metal Sash
C716.....Installing Lock-Strip Gaskets and Infill Glazing Materials
C864.....Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers
C920.....Elastomeric Joint Sealants
C1036.....Flat Glass
C1048.....Heat-Treated Flat Glass-Kind HS, Kind FT Coated and Uncoated Glass
D635.....Rate of Burning and/or Extend and Time of Burning of Self-Supporting Plastic in a Horizontal Position
D702.....Cast Methacrylate Plastic Sheets, Rods, Tubes, and Shapes
E84.....Surface Burning Characteristics of Building Materials
E774.....Sealed Insulating Glass Units

C. American National Standards Institute (ANSI):
Z97.1.....Safety Glazing Material Used in Building - Safety Performance Specifications and Methods of Test

D. Flat Glass Marketing Association (FGMA):
Glazing Manual (Latest Edition)
Sealant Manual (Latest Edition)

E. Safety Glazing Certification Council (SGCC):
Certified Products Directory (Issued Semi-Annually)

PART 2 PRODUCT

2.01 GLASS

A. Use thickness stated unless specified otherwise in assemblies.

B. Vision Panels - Clear Tempered Glass.
1. ASTM C1048, Kind FT, Condition A, Type I, Class 1, Quality q3.

2. Thickness, 3/16-inch (minimum).

2.02 GLAZING ACCESSORIES

A. As required to supplement the accessories provided with the items to be glazed and to provide a complete installation. Ferrous metal accessories exposed in the finished work shall have a finish that will not corrode or stain while in service.

B. Setting Blocks: ASTM C864:
1. Channel shape; having 1/4 inch internal depth.
2. Shore a hardness of 80 to 90 Durometer.
3. Block lengths: 2-inches except 4-6 inches for insulating glass.
4. Block width: Approximately 1/16 inch less than the full width of the rabbet.
5. Block thickness: Minimum 3/16 inch. Thickness sized for rabbet depth as required.

C. Spacers: ASTM C864:
1. Channel shape having a 1/4 inch internal depth.
2. Flanges not less 23/32 inch thick and web 1/8 inch thick.
3. Lengths: One to three inches.
4. Shore a hardness of 40 to 50 Durometer.

D. Sealing Tapes:
1. Semi-solid polymeric based material exhibiting pressure-sensitive adhesion and withstanding exposure to sunlight, moisture, heat, cold, and aging.
2. Shape, size and degree of softness and strength suitable for use in glazing application to prevent water infiltration.

E. Glazing Gaskets: ASTM C864:
1. Firm dense wedge shape for locking in sash.
2. Soft, closed cell with locking key for sash key.
3. Flanges may terminate above the glazing-beads or terminate flush with top of beads.

F. Lock-Strip Glazing Gaskets: ASTM C542, shape, size, and mounting as indicated.

G. Glazing Sealants: ASTM C920, silicone neutral cure:
1. Type S.
2. Class 25
3. Grade NS.
4. Shore A hardness of 25 to 30 Durometer.

H. Color:
1. Color of glazing compounds, gaskets, and sealants used for aluminum color frames shall match color of the finished aluminum and be nonstaining.
2. Color of other glazing compounds, gaskets, and sealants which will be exposed in the finished work and unpainted shall be black, gray, or neutral color.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verification of Conditions:
   1. Examine openings for glass and glazing units; determine they are proper size; plumb; square; and level before installation is started.
   2. Verify that glazing openings conform with details, dimensions and tolerances indicated on manufacturer's approved shop drawings.

B. Advise Contractor of conditions which may adversely affect glass and glazing unit installation, prior to commencement of installation: Do not proceed with installation until unsatisfactory conditions have been corrected.

C. Verify that wash down of adjacent masonry is completed prior to erection of glass and glazing units to prevent damage to glass and glazing units by cleaning materials.

3.02 PREPARATION

A. For sealant glazing, prepare glazing surfaces in accordance with GANA-02 Sealant Manual.

B. Determine glazing unit size and edge clearances by measuring the actual unit to receive the glazing.

C. Shop fabricate and cut glass with smooth, straight edges of full size required by openings to provide GANA recommended edge clearances.

D. Verify that components used are compatible.

E. Clean and dry glazing surfaces.

F. Prime surfaces scheduled to receive sealants, as determined by preconstruction sealant-substrate testing.

3.03 INSTALLATION - GENERAL

A. Install in accordance with GANA-01 Glazing Manual and GANA-02 Sealant Manual unless specified otherwise.

B. Glaze in accordance with recommendations of glazing and framing manufacturers, and as required to meet the Performance Test Requirements specified in other applicable sections of specifications.

C. Set glazing without bending, twisting, or forcing of units.

D. Do not allow glass to rest on or contact any framing member.

E. Glaze doors and operable sash, in a securely fixed or closed and locked position, until sealant, glazing compound, or putty has thoroughly set.

F. Tempered Glass: Install with roller distortions in horizontal position unless otherwise directed.

3.04 INSTALLATION - INTERIOR WET/DRY METHOD (TAPE AND SEALANT)

A. Cut glazing tape to length and install against permanent stops, projecting 1/16 inch above sight line.

B. Place setting blocks at 1/4 points with edge block no more than 6 inches from corners.

C. Rest glazing on setting blocks and push against tape to ensure full contact at perimeter of pane or unit.

D. Install removable stops, spacer shims inserted between glazing and applied stops at 24 inch intervals, 1/4 inch below sight line.

E. Fill gaps between pane and applied stop with S type sealant to depth equal to bite on glazing, to uniform and level line.

F. Trim protruding tape edge.

3.05 REPLACEMENT AND CLEANING

A. Clean new glass surfaces removing temporary labels, paint spots, and defacement after approval by the Architect.

B. Replace cracked, broken, and imperfect glass, or glass which has been installed improperly.

C. Leave glass, putty, and other setting material in clean, whole, and acceptable condition.

3.06 PROTECTION

A. Protect finished surfaces from damage during erection, and after completion of work. Strippable plastic coatings on colored anodized finish are not acceptable.

3.07 GLAZING SCHEDULE

A. General:
   1. Install clear tempered glass at wood and metal interior doors indicated and as shown on the drawings.

END OF SECTION

SECTION 08 91 00

LOUVERS

PART 1 - GENERAL

1.01 DESCRIPTION

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 1 – GENERAL REQUIREMENTS, which are hereby made a part of this Section of the Specifications.

B. This section specifies fixed architectural wall louvers.

1.02 SUBMITTALS

A. Submit shop drawings and products data listed below under provisions of Section 01 33 00 , SUBMITTALS.

B. Shop Drawings:
1. Each type, showing material, finish, size of members, method of assembly, and installation and anchorage details.

C. Manufacturer's Literature and Data:
1. Each type of louver and vent.

1.03 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification. The publications are referenced in the text by the basic designation only.

B. Federal Specifications (Fed. Spec.):
QQ-A-200/9C(1).....Aluminum Alloy 6063, Bar, Rod, Shapes, Tube, and Wire, Extruded
QQ-A-250/1F.....Aluminum 1100, Plate And Sheet
QQ-A-250/2E.....Aluminum Alloy 3003, Plate And Sheet
QQ-A-591F.....Aluminum Alloy Die Castings
QQ-S-766C(5).....Steel Plates, Sheets, And Strip-Corrosion Resisting
TT-P-654B.....Primer, Paint, Zinc - Molybdate, Alkyd Type

C. American Society for Testing and Materials (ASTM):
A167-89.....Stainless and Heat-Resisting Chromium - Nickel Steel Plate, Sheet, and Strip
A366-85.....Steel, Sheet, Carbon, Cold Rolled, Commercial Quality

D. National Association of Architectural Metal Manufacturers (NAAMM):
Metal Finishes Manual (Latest Edition)

E. Aluminum Association, Incorporated (AA):
45-80.....Designation System For Aluminum Finishes

F. National Fire Protection Association (NFPA):
90A-93.....Installation of Air Conditioning and Ventilating Systems

G. American Architectural Manufacturers Association (AAMA):
605.2-85.....High Performance Organic Coatings on
Architectural Extrusions and Panels

H. Air Movement and Control Association, Inc. (AMCA):
500-85.....Test Methods for Louvers, Dampers and Shutters

PART 2 - PRODUCTS

2.01 MATERIALS

A. Aluminum, Extruded: Fed. Spec. QQ-A-200/9, alloy 6063-T5 or T6.

B. Stainless Steel: ASTM A167, Type 302 or 304.

C. Carbon Steel: ASTM A366.

D. Fasteners: Fasteners for securing louvers and wall vents to adjoining construction, except as otherwise specified or shown, shall be of size and type as required for each specific type of installation and service condition.
1. Where type, size, or spacing of fasteners is not shown or specified, submit shop drawings showing proposed fasteners, and method of installation.
2. Fasteners for louvers, louver frames, and wire guards shall be of stainless steel or aluminum.

2.02 EXTERIOR WALL LOUVERS

A. General:
1. Provide fixed type louvers of size and design shown.
2. Heads, sills and jamb sections shall have formed caulking slots or be designed to retain caulking. Head sections shall have exterior drip lip, and sill sections an integral water stop.
3. Furnish louvers with sill extension or separate sill.

4. Frame shall be mechanically fastened or welded construction with welds dressed smooth and flush.

B. Performance Characteristics:
1. Weather louvers shall have a minimum of 50 percent free area and shall pass 998 fpm free area velocity at a pressure drop not exceeding 0.17 inch water gauge and carry not more than 0 ounces of water per square foot of free area for 15 minutes when tested per AMCA Standard 500.
2. Louvers shall bear AMCA certified rating seals for air performance and water penetration ratings.
3. Louver section shall withstand wind loading of 25 psi/sf (100 mph wind equivalent).

C. Aluminum Louvers:
1. General: Frames, blades, sills and mullions (sliding interlocking type); 4” deep by 0.125-inch thick extruded aluminum frame. Blades shall be 0.081” thick, drainable and fixed at 45 degree on 4" o.c., standard type and have reinforcing bosses (blade brace). Size and shape as shown on drawings.
2. Louvers, fixed: 2" thick exterior louver. Make frame sizes 1/2-inch smaller than openings. Frame shall be 2” wide all around.

2.03 CLOSURE ANGLES AND CLOSURE PLATES

A. Fabricate from 0.074-inch thick stainless steel or aluminum.

B. Provide continuous closure angles and closure plates on inside head, jambs and sill of exterior wall louvers.

C. Secure angles and plates to louver frames with screws and to wood or masonry with fasteners as specified.

2.04 INSECT SCREEN

A. Provide manufacturer's standard woven stainless steel insect screen mesh.

B. Fabricate frames from 0.081-inch thick extruded or sheet aluminum designed to retain wire mesh.

C. Miter corners and join by concealed corner clips or locks extending about 2-1/4 inches into rails and stiles.

D. Fasten frames to inside of louvers with aluminum or stainless steel devices designed to allow removal and replacement without damage to the bird screen or the louver.

2.05 FINISH

A. Aluminum Louvers:
1. Manufacturer's standard flouropolymer coating (Kynar). Dry fill thickness shall be 1.2 mil. minimum. Color shall match exterior metal wall panels.

2.06 PROTECTION

A. Provide protection for aluminum against galvanic action wherever dissimilar materials are in contact, by painting the contact surfaces of the dissimilar material with a heavy coat of bituminous paint (complete coverage), or by separating the contact surfaces with a preformed synthetic rubber tape having pressure sensitive adhesive coating on one side.

B. Isolate the aluminum from plaster, concrete and masonry by coating aluminum with zinc-chromate primer.

C. Protect finished surfaces from damage during fabrication, erection, and after completion of the work.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Set work accurately, in alignment and where shown. Items shall be plumb, level, free of rack and twist, and set parallel or perpendicular as required to line and plane of surface.

B. Furnish setting drawings and instructions for installation of anchors and for the positioning of items having anchors to be built into construction.
C. Provide anchoring devices and fasteners as shown and as necessary for securing louvers to building construction as specified. Power actuated drive pins may be used, except for removal items and where members would be deformed or substrate damaged by their use.

3.02 CLEANING AND ADJUSTING

A. After installation, all exposed prefinished and plated items and all items fabricated from stainless steel and aluminum shall be cleaned as recommended by the manufacturer and protected from damage until completion of the project.

B. All movable parts, including hardware, shall be cleaned and adjusted to operate as designed without binding or deformation of the members, so as to be centered in the

opening of frame, and where applicable, to have all contact surfaces fit tight and even without forcing or warping the components.

END OF SECTION

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SECTION 09 21 16

GYPSUM BOARD SYSTEM

PART 1 - GENERAL

1.01 SUMMARY

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 1 – GENERAL REQUIREMENTS, which are hereby made a part of this Section of the Specifications.

B. Section Includes:
   1. Gypsum board panels and finishing system.

1.02 RELATED SECTIONS

A. Section 06 10 00, ROUGH CARPENTRY.

B. Section 06 20 00, FINISH CARPENTRY.

C. Section 07 84 00, FIRESTOPPING.

D. Section 07 90 00, SEALANTS AND CAULKING.

E. Section 08 11 00, STEEL DOORS AND FRAMES.

F. Section 09 22 00, NON-LOAD BEARING FRAMING SYSTEMS.

G. Section 09 30 10, TILING.

H. Section 09 77 00, GLASS FIBER REINFORCED PLASTIC PANEL.

I. Section 09 90 01, PAINTING.

1.03 REFERENCES

A. ASTM International (ASTM):
   1. C36 – Standard Specification for Gypsum Wallboard.
   2. C442 – Standard Specification for Gypsum Backing Board, Gypsum Coreboard and Gypsum Shaftliner Board.
   3. C473 – Standard Test Methods for Physical Testing of Gypsum Panel Products.
   4. C475 – Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board.
   5. C514 – Standard Specification for Nails for the Application of Gypsum Board.

6. C840 - Standard Specification for Application and Finishing of Gypsum Board.
7. C919 - Standard Practice for Use of Sealants in Acoustical Applications.
8. C920 - Standard Specification for Elastomeric Joint Sealants.
9. C954 – Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.022 in. to 0.112 in. in Thickness.
10. C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.
11. C1047 – Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base.
12. C1178 - Standard Specification for Coated Glass Mat Water Resistant Gypsum Backing Panel.
13. C1395 – Specification for Gypsum Ceiling Board.
14. C1396 - Standard Specification for Gypsum Board.
15. C1629 - Standard Classification for Abuse Resistant Nondecorated Interior Gypsum Panel Products and Fiber reinforced Cement Panels.
16. D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber.
17. E72 - Standard Test Methods of Conducting Strength Tests of Panels for Building Construction.
18. E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
19. E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
20. E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
21. E136 - Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750 176; C.

B. Gypsum Association (GA):
   1. 214 – Recommended Levels of Gypsum Board Finish.
   2. 216 – Application and Finishing of Gypsum Panel Products.
   3. 231 – Assessing Water Damage to Gypsum Board.
   4. 238 – Guidelines for the Prevention of Mold Growth on Gypsum Board.
   5. 600 – Fire Resistance Design Manual.
   6. 801 – Handling and Storage of Gypsum Panel Product.

C. Underwriters Laboratories Inc. (UL):
   1. 263 – Standard for Fire Tests of Building Construction and Materials.
   2. FRD – Fire Resistance Directory.

1.04 PERFORMANCE REQUIREMENTS

A. Fire-Rated Assemblies: Provide materials and construction identical to those tested in fire-endurance rated assemblies by an independent testing agency acceptable to the authorities having jurisdiction.
   1. Test Method: ASTM E119 or UL 263.
   2. Ratings: As indicated on the Drawings; designations listed are from UL Fire Resistance Directory.

B. Sound-Rated Assemblies: Provide materials and construction identical to those tested in STC/IIC-rated assemblies by an independent testing agency.
   1. Test Method: ASTM E90/E492 and classified according to ASTM E413/E989.
   2. STC Ratings: As indicated on the Drawings; designations listed are from Gypsum Association GA-600, Fire Resistance Design Manual.

C. Gypsum Bead and Corner Bead:
   1. Self-Extinguishing: Shall not continue to support combustion once flame source is removed.
   2. Meet or exceed the following ASTM Standards:
      a. ASTM E84 – Achieve Class A rating for Smoke and Flame Spread.
      b. ASTM C1047 – Standard Specification for Accessories for Gypsum Wallboard.
      c. ASTM D1784 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPCV) Compounds.
      d. ASTM D3678 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Interior-Profile Extrusions.
      e. GA-216-10 – Gypsum Association.
      f. UL-2079 Standard for Tests for Fire Resistance of Building Joint Systems.
      g. Impervious to rust, galvanic corrosion, electrolysis and resistant to most chemicals.

1.05 SUBMITTALS

A. Submit in accordance with Section 01 33 00, SUBMITTALS.

B. Product Data: Manufacturer’s data sheets on each product to be used, including.
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Installation methods.

C. Shop Drawings: Indicate special details associated with fireproofing, acoustic seals, or curved sheet installations.

D. Maintenance Data: Manufacturer’s recommendations for cleaning each type of product specified.

E. Manufacturer's Certificates: Certify products meet or exceed specified requirements.

1.06 QUALITY ASSURANCE

A. Mock-Up: Provide a mock-up of an area for evaluation of surface preparation techniques and application workmanship.
   1. Locate finish areas designated by Architect.
   2. Do not proceed with remaining work until workmanship and finish is approved by Architect.
   3. Refinish mock-up area as required to produce acceptable work.

1.07 DELIVERY, STORAGE AND HANDLING

A. Deliver and store gypsum board in accordance with GA-801.

B. Ship materials with a weathertight cover and in manufacturer's original packages showing manufacturer's name and product brand name.

C. Remove plastic shipping bags upon receipt and storage. Failure to remove may increase the likelihood of mold growth.

D. Store materials inside and protected from damage by weather and direct sunlight. Stack flat; protect ends, edges, and faces of gypsum boards from damage. Protect steel studs and metal accessories from moisture.

1.08 PROJECT/SITE CONDITIONS

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

B. Do not install interior products until installation areas are enclosed and conditioned.

C. Do not install panels that are wet, those that are moisture damaged, and those that are mold damaged.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Gypsum Board Panels: United States Gypsum Co. (USG), or approved equal.

2.02 BOARD MATERIALS

A. Gypsum Board: Gypsum core panel complying with ASTM C1396, Type X.
   1. Thickness: 5/8-inch.
   2. Width: 48 inches.
   3. Length: Use longest length available, avoiding unnecessary joints.
   4. Edges: Tapered.
   5. USG Sheetrock Brand Firecode X Panels, or approved equal.

B. Mold and Mildew Gypsum Board: Moisture and mold-resistant gypsum core encased in moisture and mold-resistant faces, complying with ASTM C1396, Type X.
   1. Thickness: 5/8-inch.
   2. Width: 48 inches.
   3. Length: Use longest length available, avoiding unnecessary joints.
   4. Edges: Tapered.
   5. USG Sheetrock Brand Mold Tough Firecode X Panels, or approved equal.

C. Abuse Resistant Gypsum Board: Gypsum-fiber panels complying with ASTM C1278, Type X.
   1. Thickness: 5/8-inch.
   2. Width: 48 inches.
   3. Length: Use longest length available, avoiding unnecessary joints.
   4. USG Fiberrock Brand AR X Panels, or approved equal.

2.03 ACCESSORIES

A. Gypsum Bead:
   1. Tear Away L bead. Flat.
   2. Trim-Tek Inc., or approved equal.

B. Corner Bead:
   1. Rigid low profile corner. 90° outside. 1-3/8 inch mud flange.
   2. Trim-Tek Inc., or approved equal.

C. Metal Forms, Trims, and Caps:
   1. Aluminum Extrusions: 6063 per ASTM B221.
   2. General: Provide metals free from surface blemishes where exposed to view in finished unit. Surfaces that exhibit pitting, seam marks, roller marks, stains, and discolorations, or other imperfections on finished units are not acceptable. All metal shall be of the highest-grade commercial type.
   3. Fabrication:
      a. Provide extruded aluminum trims of design, profile and function as indicated. Select trims to suit reveal width and depth in 10’ - 0” lengths to reduce the number of end joints.

b. Provide pre-welded and soldered, mitered intersections where reveal changes direction or abuts other trim.
c. Provide pre-slotted reveals to facilitate ventilation as required with a minimum of 0.150 square inches per slot. Partial slots at joints are not acceptable when vented trims are abutted end to end.
d. In drywall construction when post-applied attachment flanges are used, trims must be slotted with a minimum of 0.375 square inches per lineal foot of flange to properly bond with the bedding compound and drywall.
e. All attachment flanges are perforated to allow attachment to the structure of a minimum of 8" O.C.

4. Finish: All material shall be finished with an Alodine Chromate Conversion coating suitable for priming and painting in the factory or field.
5. Metal Corner Protector: Final Forms I, #901-SC-1250 as manufactured by Gordon Interior Specialties, or approved equal.

D. Access Panels:
1. Interior Flush, Non Fire Rated Access Panels: Style TMW by JL Industries, or approved equal.
a. Frame: 16 gauge steel with 1 inch drywall bead which can be taped and mudded for a smooth appearance.
b. Panel: 16 gauge steel with continuous concealed hinge.
c. Finish: Powder coat paint – white.
d. Standard Latch/Lock: Flush screwdriver operated steel cam.
e. Gaskets: 3 sides of door.
f. General Use: Walls or ceilings.
g. Nominal Size: 12 inches by 12 inches, unless otherwise noted.
2. Interior Flush Fie Rated Access Panels: Style FD by JL Industries, or approved equal.
a. Frame and Trim: 16 gauge steel with 1 inch flange, and welded-on masonry anchor.
b. Panel: Insulated 20 gauge steel with continuous hinge, 2 inch thickness.
c. Finish: Powder coat paint – white.
d. Standard Latch/Lock: Universal turn ring and key lock "U".
e. General Use: Walls or ceilings.
f. Nominal Size: 12 inches by 12 inches, unless otherwise noted.
g. Fire Rating:
1) Walls: 1-1/2 hour UL "B" label in a 2 hour fire barrier.
2) Ceilings: Warnock Hersey listed for floor or ceiling installations with 3 hour noncombustible rating; or 1 hour combustible rating.

2.04 FASTENERS

A. Screws: ASTM C 954 or ASTM C 1002 or both with heads, threads, points, and finish as recommended by panel manufacturer.

B. Nails: ASTM C 514 with heads, lengths, configurations, and finish as recommended by panel manufacturer.

C. For fire rated construction, type and size as required for specified fire rating test.

2.05 JOINT MATERIALS

A. Joint Treatment Materials: ASTM C 475; type recommended by manufacturer of sheet products and joint treatment materials for application indicated, unless indicated otherwise.

B. Joint Tape:
   1. Interior Gypsum Board: Paper reinforced tape.
   2. Mold and Mildew Resistant Backer Board: Glass mesh tape.

C. Setting Type Joint Compound: Factory prepackaged, job mixed chemical-hardening powder products for bedding and filling, formulated for uses indicated.
   1. For taping and filling only.
   2. For prefilling gypsum board joints.
   3. For filling joints and treating fasteners of water-resistant gypsum backing board behind base for ceramic tile.
   4. For filling joints and treating fasteners of mold and mildew resistant backing board behind base for ceramic tile.
   5. For filling joints and treating fasteners of gypsum base for veneer plaster.
   6. For topping compound, use sandable formulation.

D. Drying-Type Joint Compounds: Factory prepackaged vinyl-based products complying with the following requirements for formulation and intended use.
   1. Ready-Mix Formulation: Factory-mixed product.
   2. All-purpose compound formulated for use as both taping and topping compound; use for finish (third) coat only.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify site conditions are ready to receive work and framing and opening dimensions are as indicated on the Drawings.

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

3.02 PREPARATION

A. Clean surfaces thoroughly prior to installation.

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

3.03 GYPSUM BOARD HEIGHTS

A. Extend all layers of gypsum board from floor to underside of structure overhead on the following partitions and furring:
   1. Two sides of partitions:
      a. Fire rated partitions.
      b. Smoke partitions.
      c. Sound rated partitions.
      d. Full height partitions shown.
      e. As noted on Drawings.
   2. One side of partitions or furring:
      a. Inside of exterior wall furring or stud construction.
      b. Room side of room without suspended ceiling.
      c. Furring for pipes and duct shafts, except where fire rated shaft wall construction is shown.
   3. Extend all layers of gypsum board construction used for fireproofing of columns from floor to underside of structure overhead, unless otherwise shown.

B. In locations other than those specified, extend gypsum board from floo to heights as follows:
   1. Not less than 6 inches above suspended acoustical ceilings.
   2. At ceilings of suspended gypsum board ceilings.
   3. At existing ceilings.

3.04 INSTALLING GYPSUM BOARD

A. Application: Apply and maintain conditions during installation in accordance with GA-216 and GA-238 and as follows:
   1. Keep gypsum board dry throughout application.
   2. Do not use gypsum board that has visible mold growth.
   3. Apply gypsum board on walls with a minimum 1/4 inch gap between the gypsum board and the floor.
   4. Do not apply gypsum board over other building materials where conditions exist that are favorable to mold growth.
   5. Maintain a sound weather-tight building envelope including, such elements as the roof, sealants, windows, etc.

6. Immediate and appropriate remediation measures must be taken as soon as water leaks or condensation sources are identified.
7. Provide routine cleaning and maintenance operations to prevent saturation of the gypsum board.
8. If gypsum board is damaged by water, assess the need for replacement in accordance with GA-231.

B. Install accordance with GA 216 and the following:
1. Metal Framing: ASTM C54.
2. Fire-Resistant Construction: GA 600.
3. Gypsum Board and Joint Treatment: ASTM C840 and GA-214.
4. Gypsum panel manufacturer's published recommendations.

C. Single Layer Gypsum Board on Metal Studs:
1. Loosely butt gypsum board joints together and neatly fit.
2. Maximum allowable gap at end joints: 1/8 inch.
3. Stagger joints on opposite sides of partitions.
4. Apply ceiling boards first where gypsum board ceilings and wall occur.
5. Cut openings in gypsum board to fit electrical outlets, plumbing, light fixtures and piping snugly and small enough to be covered by plates and escutcheons. Cut both face and back paper.

D. Single Layer Gypsum Board on Furring:
1. Apply gypsum board with long dimension at right angles to furring channel.
2. Center end joints over channel web; stagger end joints from those in adjacent rows of board.

E. Double Layer Gypsum Board:
1. Fasten base layer to studs or furring with screws, and attach face layer using laminating adhesive and screws, applied according to manufacturer's instructions
2. Offset face-layer joints at least 10 inches from parallel base-layer joints.
3. Screw both layers to metal supports at double layer ceiling applications and where required for fire-rated construction.

F. Moisture and Mold–Resistant Assemblies:
1. Complete plumbing rough-in before gypsum board panels are erected.
2. Separate gypsum panels from rough-in and fixtures by 1/4 inch space.
3. Make necessary cut-outs and seal cut or exposed panel edges with thinned-down ceramic tile adhesive or with waterproof flexible sealant, as recommended by gypsum board manufacturer.
4. Install water-resistant board horizontally.
5. Do not place water-resistant board directly over vapor retarder.
6. Prior to tile application, fill openings around pipes, fittings, fixtures, interior angles and other penetrations with waterproof flexible sealant, as recommended by gypsum board manufacturer. Do not fill 1/4 inch gap at bottom of panels.
7. Note: Provide in restroom and locker rooms and as otherwise specified.

G. Accessories:
   1. Set accessories plumb, level and true to line, neatly mitered at corners and intersections, and securely attach to supporting surfaces as specified.
   2. Install in one piece, without the limits of the longest commercially available lengths.
   3. Corner Beads:
      a. At both sides of expansion and control joints unless shown otherwise.
      b. Where gypsum board terminates against dissimilar materials and at perimeter of openings, except where covered by flanges, casings or permanently built-in equipment.
      c. Where gypsum board surfaces of non-load bearing assemblies abut load bearing members.
      d. Where shown.
   4. Edge Trim (casings Beads):
   5. Specialty Accessories:
      a. Install in accordance with manufacturer's recommendations.

3.05 FINISHING OF GYPSUM BOARD

A. Finish joints, edges, corners, and fastener heads in accordance with ASTM C840. Use **Level IV** finish for all finished areas open to public view.

B. Before proceeding with installation of finishing materials, assure the following:
   1. Gypsum board is fastened and held close to framing or furring.
   2. Fastening heads in gypsum board are slightly below surface in dimple formed by driving tool.

C. Finish joints, fasteners, and all openings, including openings around penetrations, on that part of the gypsum board extending above suspended ceilings to seal surface of non decorated smoke barrier, fire rated and sound rated gypsum board construction. After the installation of hanger rods, hanger wires, supports, equipment, conduits, piping and similar work, seal remaining openings and maintain the integrity of the smoke barrier, fire rated and sound rated construction. Sanding is not required of non decorated surfaces.

3.06 REPAIRS

A. After taping and finishing has been completed, and before decoration, repair all damaged and defective work, including non-decorated surfaces.

B. Patch holes or openings 1/2 inch or less in diameter, or equivalent size, with a setting type finishing compound or patching plaster.

C. Repair holes or openings over 1/2 inch diameter, or equivalent size, with 5/8 inch thick gypsum board secured in such a manner as to provide solid substrate equivalent to undamaged surface.

D. Tape and refinish scratched, abraded or damaged finish surfaces including cracks and joints in non-decorated surface to provide smoke tight construction, fire protection equivalent to the fire rated construction and STC equivalent to the sound rated construction.

END OF SECTION

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SECTION 09 22 00

NON-LOAD BEARING FRAMING SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 1 – GENERAL REQUIREMENTS, which are hereby made a part of this Section of the Specifications.

B. Section Includes:
   1. Non-load bearing steel framing systems for interior partitions.
   2. Suspension systems for interior ceilings and soffits.

1.02 RELATED SECTIONS

A. Section 06 10 00, ROUGH CARPENTRY.

B. Section 09 21 16, GYPSUM BOARD SYSTEM.

C. Section 13 34 19, PRE-ENGINEERED BUILDING.

1.03 REFERENCES

A. American Iron and Steel Institute (AISI):
   1. S202 - North American Standards for Cold-Formed Steel Framing, Code of Standard Practice.
   2. S220 - North American Specification for the Design of Cold-Formed Steel Framing – Nonstructural Members.

B. ASTM International (ASTM):
   1. A641/A641M – Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire.
   2. A653/A653M – Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
   3. A1003/A1003M – Standard Specification for Steel Sheet, Carbon, Metallic and Nonmetallic Coated for Cold-Formed Framing Members.
   4. B633 – Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel.
   5. C645 – Standard Specification for Nonstructural Steel Framing Members.
   6. C754 – Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products.

7. C840 – Standard Specification for Application and Finishing of Gypsum Board.
8. E90 – Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
9. E119 – Standard Test Methods for Fire Tests of Building Construction and Materials.
10. E413 – Classification for Rating Sound Insulation.
11. F1941 – Standard Specification for Electrodeposited Coatings in Mechanical Fasteners, Inch and Metric.

1.04 SUBMITTALS

A. Submit in accordance with Section 01 33 00, SUBMITTALS.

B. Product Data: For each type of product.

C. Product Certificates: For each type of code-compliance certification for studs and tracks.

D. Evaluation Reports: Submit evaluation reports certified under an independent third-party inspection program administered by an agency accredited by IAS to ICC-ES AC98 IAS accreditation criteria for inspection agencies.

E. Manufacturer's Certification: Submit manufacturer's certification of product compliance with codes and standards along with product literature and data sheets for specified products.

1.05 QUALITY ASSURANCE

A. Code-Compliance Certification of Studs and Tracks: Provide documentation that framing members are certified in accordance with the product-certification program of the Steel Framing Industry Association (SFIA) or a similar organization that provides a verifiable code compliance program.

B. Contractor shall provide effective, full-time quality control over all fabrication and erection complying with pertinent codes and regulations of government agencies having jurisdiction. Conduct preinstallation meeting to verify Project requirements, substrate conditions, and manufacturer's written installation instructions.

1.06 DELIVERY, STORAGE AND HANDLING

A. Notify manufacturer of damaged materials received prior to installation.

B. Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.

C. Protect cold-formed metal framing from corrosion, deformation, and other damage during delivery, storage, and handling as required by AISI S202 "Code of Standard Practice."

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: For fire-resistance rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated, in accordance with ASTM E119, and displaying a classification label from an independent testing agency acceptable to 780 CMR, 9th edition.
   1. Construct fire-resistance rated partitions and ceilings in compliance with tested assembly requirements indicated on Drawings.
   2. Rated assemblies to be substantiated from applicable testing using proposed products, by Contractor.

B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assemblies indicated on Drawings, in accordance with ASTM E90 and classified in accordance with ASTM E413 by an independent testing agency.

C. Horizontal Deflection: For composite and non-composite wall assemblies, limited to l/360 of the wall height based on horizontal loading of 5lbf/sq.ft.

D. Design framing systems in accordance with AISI S220, "North American Specification for the Design of Cold-Formed Steel Framing – Nonstructural Members," unless otherwise indicated.

E. Design Loads: As indicated on Drawings or 5 lb/sq.ft. minimum as required by 780 CMR, 9th edition.

F. Design framing systems to accommodate deflection of primary building structure and construction tolerances.

2.02 MANUFACTURER

A. Acceptable Manufacturer: ClarkDietrich Building Systems, or approved equal.

2.03 FRAMING SYSTEMS

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

B. Framing Members, General: Comply with AISI S220 and ASTM C645, Section 10 for conditions indicated.
   1. Steel Sheet Components: Comply with AISI S220 and ASTM C645, Section 10 for conditions indicated.
   2. Protective Coating: Comply with AISI S220 and ASTM C645; ASTM A653/A653M, G40; or coating with equivalent corrosion resistance of ASTM A653/A653M, G40 and demonstrate equivalent corrosion resistance with an evaluation report acceptable to authorities having jurisdiction; or coating roll-formed from steel complying with mechanical and chemical requirements of ASTM A1003 with a zinc-based coating and demonstrate equivalent corrosion resistance with an evaluation report acceptable to 780 CMR, 9th edition. Galvannealed products are unacceptable.
      a. Basis of Design Product: ClarkDietrich ProSTUD/ProTRAK G40, or approved equal.

C. Non-Structural Studs and Track: AISI 220 and ASTM C645, Section 10.
   1. Non-Structural Studs: Cold-formed steel C-studs for conditions indicated below:
      a. Basis of Design Product: ClarkDietrich ProSTUD, or approved equal.
      b. Flange Size: 1-1/4 inches.
      c. Web Depth: As indicated on Drawings.
      d. Member Description: 25 ga., 50 ksi.
         1) Minimum Base-Steel Thickness: 0.0150 inch.
         2) Minimum Design Thickness: 0.0158 inch.
   2. Non-Structural Track: Cold-formed steel drywall track for conditions indicated below:
      a. Basis of Design Product: ClarkDietrich ProTRAK, or approved equal.
      b. Flange Size: 1-1/4 inches.
      c. Web Depth: Track web to match stud web size.
      d. Minimum Base-Steel Thickness: Track thickness to match wall stud thickness or as per design.
   3. Equivalent Gauge Thickness (“EQ”) Steel Studs and Runners: Members that can show certified third-party testing with gypsum board in accordance with ICC-ES AC86 need not comply with minimum thickness limitation or minimum section properties set forth in ASTM C645. Submission of an equivalent report is acceptable to show compliance with this requirement.

D. Slip-Type Head Joints: Provide one of the following:
   1. Clip System: Clips designed for use in head-of-wall deflection conditions that provide a positive attachment of studs to tracks while allowing 1-1/2 inch minimum vertical movement.

a. Basis of Design Product: ClarkDietrich Fast Top Clip FTC3, or approved equal.

2. Single Long-Leg Track System: ASTM C645 top track with 2-inch deep flanges in thickness not less than indicated for studs, installed with studs friction fit into top track and with continuous bridging and spacer bar located within 12 inches of the top of studs to provide lateral bracing.
   a. Basis of Design Product: ClarkDietrich BlazeFrame DL Deflection Track, or approved equal.
3. Single Long-Leg Track System: Top track with 2-inch deep flanges in thickness not less than indicated for studs, installed with studs friction fit into top track and with continuous bridging and spacer bar located within 12 inches of the top of studs to provide lateral bracing.
   a. Basis of Design Product: ClarkDietrich Cold-Formed Channel and EasyClip U-Series Angle U543 or U545, or approved equal.

E. Firestop Tracks: Top track manufactured to allow partition heads to expand and contract with movement of structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.
   1. Basis of Design Product: ClarkDietrich BlazeFrame, or approved equal.

F. Channel Bridging and Bracing: Pre-notched steel, 7/8 by 7/8 by 50 inches, 0.0329-inch minimum base-steel thickness.
   1. Basis of Design Product: ClarkDietrich Spazzer 9200 Bridging and Spacing Bar, or approved equal.

G. U-Channel Bridging: Steel, 0.0538-inch minimum base-steel thickness, with minimum ½-inch wide flanges.
   1. Basis of Design Product: ClarkDietrich Cold-Formed U-Channel and Channel Clip CC33, or approved equal.
   2. U-Channel Depth: ¾-inch.

H. Rigid Furring Channels: Hat-shaped channels.
   1. Basis of Design Product: ClarkDietrich Furring Channel, or approved equal.
   2. Minimum Base-Steel Thickness: 0.0179 inch.
   3. Depth: 7/8-inch.

I. Resilient Furring Channels: ½-inch deep, steel sheet members designed to reduce sound transmission.
   1. Basis of Design Product: ClarkDietrich RC Deluxe (RCSD) Resilient Channel, or approved equal.
   2. Configuration: Asymmetrical.

J. Carrying Channels: 0.053-inch uncoated steel thickness, with minimum ½-inch wide flanges.
   1. Depth: As indicated on Drawings.

2. Furring Brackets: Adjustable, corrugated-edge-type steel sheet with minimum uncoated-steel thickness of 0.0296 inch.
3. Tie Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.062-inch diameter wire, or double strand of 0.048-inch diameter wire.

2.04 SUSPENSION SYSTEM

A. Tie Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.062-inch diameter wire, or double strand of 0.048-inch diameter wire.

B. Hanger Attachment to Concrete:
1. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01, AC193, AC58, or AC308 as appropriate for the substrate.
   a. Uses: Securing hangers to structure.
   b. Type: Torque-controlled expansion anchor, torque-controlled adhesive anchor, or adhesive anchor.
   c. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B633 or F1941, Class Fe/Zn 5, unless otherwise indicated.
2. Power-Actuated Anchors: Fastener systems with an evaluation report acceptable to 780 CMR, 9th edition, based on ICC-ES AC70.

C. Wire Hangers: ASTM A641/A641M, Class 1, zinc coating, soft temper, 0.16 inch in diameter.

D. Flat Hangers: Steel sheet, 1 by 3/16 inch.

2.05 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards.
1. Fasteners for Steel Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrate.

B. Isolation Strip at Exterior Walls: Provide one of the following:
1. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8-inch thick, in width to suit steel stud size.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.

3.03 INSTALLATION, GENERAL

A. Installation Standard: ASTM C754.
   1. Gypsum Board Assemblies: Also comply with requirements in ASTM C840 that apply to framing installation.

B. Installing framing and accessories plumb, square, and true to line, with connections securely fastened.

C. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.

D. Install bracing at termination in assemblies.

E. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joint independently.

3.04 INSTALLING FRAMED ASSEMBLIES

A. Install framing system components with spacings indicated but not greater than spacings required by referenced installation standards for assembly types.

B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.

C. Install studs so flanges within framing system point in same direction.

D. Install tracks at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated

to terminate at suspended ceilings. Continue framing around ducts that penetrate partitions above ceiling.

1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at top of framing system that prevent axial loading of finished assemblies.
2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install track section (for cripple studs) at head and secure to jamb studs.
   a. Install two studs at each jamb unless otherwise indicated.
   b. Install cripple studs at head adjacent to each jamb stud, with a minimum ½-inch clearance from jamb stud to allow for installation of control joint in finished assembly.
   c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.
3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.
   a. Install fire-resistant partitions using manufacturer's proprietary equivalent-gauge studs in compliance with requirements of UL assemblies indicated on Drawings.
   b. Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.
5. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.

E. Direct Furring:
   1. Screw to wood framing.
   2. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.

F. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

3.05 INSTALLING CEILING SUSPENSION SYSTEM

A. Install suspension system components in accordance with spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
   1. Hangers: 48 inches o.c.
   2. Carrying Channels (Main Runners): 24 inches o.c.
   3. Furring Channels (Furring Members): 16 inches o.c.

B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.

C. Suspend hangers from building structure as follows:
   1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.
      a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
   2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
      a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.
   3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
   4. Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.
   5. Do not attach hangers to steel roof deck.
   6. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
   7. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
   8. Do not connect or suspend steel framing from ducts, pipes, or conduit.

D. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.

E. Seismic Bracing: Sway-brace suspension systems with hangers used for support.

F. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION

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SECTION 09 30 10

TILING

PART 1 GENERAL

1.01 DESCRIPTION

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 1 – GENERAL REQUIREMENTS, which are hereby made a part of this Section of the Specifications.

B. This section specifies ceramic tile and marble thresholds.

1.02 RELATED WORK

A. Section 03 30 00, CAST-IN-PLACE CONCRETE.

B. Section 04 20 01, UNIT MASONRY.

C. Section 07 90 00, SEALANTS AND CAULKING.

D. Section 09 21 16, GYPSUM BOARD SYSTEM.

1.03 SUBMITTALS

A. Submit in accordance with Section 01 33 00, SUBMITTALS.

B. Samples:
1. Floor and base tile, each type, each color, each size.

C. Product Data:
1. Ceramic tile, marked to show each type, size, and shape required.
2. Leveling compound.
3. Latex-Portland cement mortar and grout.
4. Commercial Portland cement grout.
5. Slip resistant tile.

D. Certificates:
1. Master grade, ANSI A137.1.
2. Manufacturer's certificates indicating that the following materials comply with specification requirements:
a. Commercial Portland cement grout.
b. Latex-Portland cement mortar and grout.

c. Leveling compound.

1.04 DELIVERY AND STORAGE

A. Deliver materials in containers with labels legible and intact and grade-seals unbroken.

B. Store material so as to prevent damage or contamination.

1.05 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification. The publications are referenced in the text by the basic designation only.

B. American National Standards Institute (ANSI) (Published by Tile Council of America, Inc.):
A108.1…….....Glazed Wall Tile, Ceramic Mosaic Tile, Quarry and Paver Tile Installed with Portland Cement Mortar
A108.4 …….....Ceramic Tile Installed with Organic Adhesives or Water Cleanable Tile-Setting Epoxy Adhesive
A108.5 …….....Ceramic Tile Installed with Dry-Set Portland Cement Mortar or Latex-Portland Cement Mortar
A108.6 …….....Ceramic Tile Installed with Chemical-Resistant, Water-Cleanable Tile-Setting and Grouting Epoxy
A108.8 …….....Ceramic Tile Installed with Chemical-Resistant Furan Mortar and Grout
A108.10 …….....Installation of Grout in Tile work.
A118.1…….....Dry-Set Portland Cement Mortar
A118.3 …….....Chemical-Resistant, Water-Cleanable Tile-Setting and Grouting Epoxy and Water-Cleanable Tile-Setting Epoxy Adhesive
A118.4 …….....Latex-Portland Cement Mortar
A118.5 …….....Chemical-Resistant Furan Mortars and Grouts
A118.6 …….....Ceramic Tile Grouts
A136.1 …….....Organic Adhesives for Installation of Ceramic Tile
A137.1 ….....Ceramic Tile

C. American Society For Testing And Materials (ASTM):
A185 ….....Steel Welded Wire Fabric, Plain, for Concrete Reinforcing
C150 ….....Portland Cement
C331 ….....Lightweight Aggregate for Concrete Masonry Units
C426 ……...Drying Shrinkage of Concrete Block
C473 ….....Testing of Gypsum Board Products and Gypsum Lath
C841 ….....Installation of Interior Lathing and Furring

C847 ….....Metal Lath
C947 ….....Test Method for Flexural Properties of Thin-Section Glass Fiber-Reinforced Concrete (Using Simple Beam with Third-Point Loading)
C948 ……....Test Method for Dry and Wet Bulk Density, Water Absorption and Apparent Porosity of thin Sections of Glass Fiber-Reinforced Concrete
C957 ….....High Solids Content, Cold Liquid-Applied Elastomeric Waterproofing Membrane with Integral Wearing Surface
C979 ….....Pigments for Integrally Colored Concrete
C1002 ….....Steel Drill Screws for the Application of Gypsum Board
D412 ….....Rubber Properties in Tension
D1004 ……..Initial Tear Resistance of Plastic and Sheeting
D1037 .....Evaluating the Properties of Wood Base Fiber and Particle Panel Materials
D1204 ….....Linear Dimensional Changes of Nonrigid Thermoplastic Sheeting or Film at Elevated Temperature
D2240 ….....Rubber Property-Durometer Hardness
D2394 ….....Simulated Service Testing of Wood and Wood-Base Finish Flooring
D2497 ……..Tolerances for Man-Made Organic-Base Filament Single Yarns
D3045 ……..Heat Aging of Plastics Without Load
D4397 ….....Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications.
E96 .....Water Transmission of Materials

D. Marble Institute of America (MIA):
Design Manual III- Latest Edition

PART 2 PRODUCTS

2.01 TILE

A. General: Provide tile that complies with ANSI A137.1 for types, compositions and other characteristics indicated. Provide tile in the locations and of the types colors and pattern indicated on the drawings and identified in the schedule in this Section. Tile shall also be provided in accordance with the following:
   1. Factory Blending: For tile exhibiting color variations within the ranges selected under Submittal of samples, blend tile in the factory and package so tile taken from one package shows the same range of colors as those taken from other packages.
   2. Mounting: For factory mounted tile, provide back or edge mounted tile

assemblies as standard with the manufacturer, unless otherwise specified.

3. Factory Applied Temporary Protective Coatings: Where indicated under tile type, protect exposed surfaces of tile against adherence of mortar and grout by precoating with a continuous film of petroleum paraffin wax applied hot. Do not coat unexposed tile surfaces.
4. Factory Cut: Tile shall be cut in factor for “true edges” in sizes specified and as shown on drawings.

B. ColorBody Porcelain Tile:
1. Water Absorption: ASTM C373, <0.5% to less than 20 percent.
2. Breaking Strength: ASTM C648, >320 lbs.
3. Scratch Hardness: ASTM MOH’s, 6.5.
4. Chemical Resistance: ASTM C650, Resistant.
5. Coefficient of Friction: ASTM C1028, Wet $\geq$ 0.60, Dry $\geq$ 0.66.
6. Pattern: As indicated on the drawings.
7. Trim Units: Matching bullnose, cove base corner, cove base outcorner, jolly, grooved bullnose, cement bullnose, fabric bullnose, shapes in sizes coordinated with field tile.

2.02 CERAMIC TILE

A. Ceramic Tile #1: Nominal 12” x 12” x 3/8-inch thick as shown on drawings.
1. Manufacturer: DalTile or "approved equal".
2. Series: Torreon™
3. Code: TN98
4. Description: Color Body Porcelain Ceramic
5. Color: Brino
6. Grout Joint Dimension: 1/8”
7. Location: Restrooms and Locker Rooms.
8. Pattern: As shown on drawings.

B. Ceramic Tile #2:
1. ANSI a108.10, Standard Grade.
2. Nominal 4" x 4" x 5/16-inch thick with cushion edges and water absorption of 13-15 percent in accordance with ASTM C373. One color and one manufacturer.
3. Trim Shapes: Trim shall conform to applicable requirements of adjoining edge condition.
4. Color: DalTile “Urban Putty #6461” or approved equal.

2.03 SETTING MATERIALS OR BOND COATS

A. Conform to TCA Handbook for Ceramic Tile Installation.

B. Portland Cement Mortar: ANSI A108.1.

C. Latex-Portland Cement Mortar: ANSI A118.4.
   1. For wall applications, provide non-sagging, latex-Portland cement mortar complying with ANSI A118.4.
   2. Prepackaged Dry-Mortar Mix: Factory-prepared mixture of Portland cement; dry, redispersible, ethylene vinyl acetate additive; and other ingredients to which only water needs to be added at Project site.

D. Dry-Set Portland Cement Mortar: ANSI A118.1. For wall applications, provide non-sagging, latex-Portland cement mortar complying with ANSI A118.4.

E. Organic Adhesives: ANSI A136.1, Type 1.

2.04 GROUTING MATERIALS

A. Coloring Pigments:
   1. Pure mineral pigments, limeproof and nonfading, complying with ASTM C979.
   2. Add coloring pigments to grout by the manufacturer.
   3. Job colored grout is not acceptable.
   4. Use is required in Commercial Portland Cement Grout, Dry-Set Grout, and Latex-Portland Cement Grout.

B. Commercial Portland Cement Grout: ANSI A118.6 color as specified.

C. Dry-Set Grout: ANSI A118.6 color as specified.

D. Latex-Portland Cement Grout: ANSI A118.6 color as specified.
   1. Unsanded grout mixture for joints 3.2 mm (1/8 inch) and narrower.
   2. Sanded grout mixture for joints 3.2 mm (1/8 inch) and wider.

E. Color: Laticrete unsanded grout “17 Marble Beige and #22 Midnight Black” or approved equal.

2.05 PATCHING AND LEVELING COMPOUND

A. Portland cement base, polymer-modified, self-leveling compound, manufactured specifically for resurfacing and leveling concrete floors. Products containing gypsum are not acceptable.
B. Shall have minimum following physical properties:
   1. Compressive strength - 3500 psig per ASTM C109/C109M.
   2. Flexural strength - 1000 psig per ASTM C348 (28 day value).
   3. Tensile strength - 600 psi per ANSI 118.7.
   4. Density – 1.9.

C. Capable of being applied in layers up to 1-1/2 inches thick without fillers and up to four inches thick with fillers, being brought to a feather edge, and being trowelled to a smooth finish.

D. Primers, fillers, and reinforcement as required by manufacturer for application and substrate condition.

E. Ready for use in 48 hours after application.

2.06 METAL EDGES

A. L-Shaped Profile (Horizontal and Vertical Exposed Edges):
   1. Schluter®-JOLLY, or approved equal. L-shaped profile with 1/8 inch wide top section and 3/16 - 1/2 inch wide face, that form the visible surface, integrated trapezoid-perforated anchoring leg, and integrated grout joint spacer.
   2. Material and Finish: Brushed chrome anodized aluminum.

B. Bullnose Profile (Outside Corners):
   1. Schluter®-RONDEC, or approved equal. bullnose-type profile with symmetrically rounded visible surface with 1/4 inch radius, integrated trapezoid-perforated anchoring leg, and integrated grout joint spacer.
   2. Material and Finish: Brushed chrome anodized aluminum.

2.08 WATER

A. Clean, potable and free from salts and other injurious elements to mortar and grout materials.

2.09 CLEANING COMPOUNDS

A. Specifically designed for cleaning masonry and concrete and which will not prevent bond of subsequent tile setting materials including patching and leveling compounds and elastomeric waterproofing membrane and coat.

B. Materials containing acid or caustic material not acceptable.

2.10 FLOOR MORTAR BED REINFORCING

A. ASTM A185 welded wire fabric without backing, MW3 x MW3 (2 x 2-W0.5 x W0.5).

2.11 SEALER

A. High performance transparent penetrating silicone sealer for ceramic tile and grout.

B. Manufacturer: “Super- Sealcote” by Super-Tek Products or approved equal.

PART 3 EXECUTION

3.01 ENVIRONMENTAL REQUIREMENTS

A. Maintain ambient temperature of work areas at not less than 60 degrees F, without interruption, for not less than 24 hours before installation and not less than three days after installation.

B. Maintain higher temperatures for a longer period of time where required by manufacturer's recommendation and ANSI Specifications for installation.

C. Do not install tile when the temperature is above 100 degrees F.

D. Do not install materials when the temperature of the substrate is below 60 degrees F.

E. Do not allow temperature to fall below 50 degrees F after fourth day of completion of tile work.

3.02 ALLOWABLE TOLERANCE

A. Variation in plane of sub-floor, including concrete fills leveling compounds and mortar beds:
   1. Not more than 1/4 inch in 10 feet from required elevation where Portland cement mortar setting bed is used.
   2. Not more than 1/8 inch in 10 feet where dry-set Portland cement, and latex-Portland cement mortar setting beds and chemical-resistant bond coats are used.

B. Variation in Plane of Wall Surfaces:
   1. Not more than 1/4 inch in eight feet from required plane where Portland cement mortar setting bed is used.
   2. Not more than 1/8 inch in eight feet where dry-set or latex-Portland cement mortar or organic adhesive setting materials is used.

3.03 SURFACE PREPARATION

A. Cleaning New Concrete or Masonry:
   1. Chip out loose material, clean off all oil, grease dirt, adhesives, curing compounds, and other deterrents to bonding by mechanical method, or by using products specifically designed for cleaning concrete and masonry.
   2. Use self-contained power blast cleaning systems to remove curing compounds and steel trowel finish from concrete slabs where ceramic tile will be installed directly on concrete surface with thin-set materials.
   3. Steam cleaning or the use of acids and solvents for cleaning will not be permitted.

B. Patching and Leveling:
   1. Mix and apply patching and leveling compound in accordance with manufacturer's instructions.
   2. Fill holes and cracks and align concrete floors that are out of required plane with patching and leveling compound.
      a. Thickness of compound as required to bring finish tile system to elevation shown.
      b. Float finish except finish smooth for elastomeric waterproofing.
      c. At substrate expansion, isolation, and other moving joints, allow joint of same width to continue through underlayment.
   3. Apply patching and leveling compound to concrete and masonry wall surfaces that are out of required plane.
   4. Apply leveling coats of material compatible with wall surface and tile setting material to wall surfaces, other than concrete and masonry that are out of required plane.

C. Mortar Bed for Slopes to Drains:
   1. Slope compound to drain where drains are shown.
   2. Install mortar bed in depressed slab sloped to drains not less than 1/16 inch per foot.
   3. Allow not less than 2 inch depression at edge of depressed slab.
   4. Screed for slope to drain and float finish.
   5. Cure mortar bed for not less than seven days. Do not use curing compounds or coatings.

D. Additional preparation of concrete floors for tile set with epoxy, or furan-resin shall be in accordance with the manufacturer's printed instructions.

E. Cleavage Membrane:
   1. Install polythene sheet as cleavage membrane in depressed slab when waterproof membrane is not scheduled or indicated.
   2. Turn up at edge of depressed floor slab to top of floor.

F. Walls:
   1. Apply patching and leveling compound to concrete and masonry surfaces that are out of required plane.
   2. Apply leveling coats of material compatible with wall surface and tile setting material to wall surfaces, other than concrete and masonry that are out of required plane.

3.04 METAL DIVIDER STRIPS

A. Install metal divider strips in floor joints between ceramic and quarry tile floors and between tile floors and adjacent flooring of other materials where the finish floors are flush unless shown otherwise.

B. Set divider strip in mortar bed to line and level centered under doors or in openings.

3.05 CERAMIC TILE - GENERAL

A. Comply with ANSI A108 series of tile installation standards in "Specifications for Installation of Ceramic Tile" applicable to methods of installation.

B. Comply with TCA Installation Guidelines:

C. Installing Mortar Beds for Floors:
   1. Install mortar bed to not damage cleavage or waterproof membrane;1-1/2 inch minimum thickness.
   2. Install floor mortar bed reinforcing centered in mortar fill.
   3. Screed finish to level plane or slope to drains where shown, float finish.
   4. For thin set systems cure mortar bed not less than seven days. Do not use curing compounds or coatings.
   5. For tile set with Portland cement paste over plastic mortar bed coordinate to set tile before mortar bed sets.

D. Setting Beds or Bond Coats:
   1. Where recessed or depressed floor slabs are filled with Portland cement mortar bed, set ceramic mosaic floor tile in either Portland cement paste over plastic mortar bed or latex-Portland cement mortar over cured mortar bed except as specified otherwise, ANSI A108-1C, TCA System F121-02 or F111-02.
   2. Set wall tile installed over concrete or masonry in dry-set Portland cement mortar, or latex-Portland cement mortar, ANSI 108.1B.and TCA System W211-02, W221-02 or W222-02.
   3. Set wall tile installed over concrete backer board in latex-Portland cement mortar, ANSI A108.1B.
   4. Set wall tile installed over Portland cement mortar bed on metal lath base in Portland cement paste over plastic mortar bed, or dry-set Portland cement mortar or latex-Portland cement mortar over a cured mortar bed, ANSI A108.1C, TCA System W231-02, W241-02.
   5. Set tile installed over gypsum board and gypsum plaster in organic adhesive, ANSI A108.4, TCA System W242-02.
   6. Set trim shapes in same material specified for setting adjoining tile.

E. Workmanship:
   1. Lay out tile work so that no tile less than one-half full size is used. Make all cuts on the outer edge of the field.
   2. Set tile firmly in place with finish surfaces in true planes. Align tile flush with adjacent tile unless shown otherwise.
   3. Form intersections and returns accurately.
   4. Cut and drill tile neatly without marring surface.
   5. Cut edges of tile abutting penetrations, finish, or built-in items:
      a. Fit tile closely around electrical outlets, piping, fixtures and fittings, so that plates, escutcheons, collars and flanges will overlap cut edge of tile.
      b. Seal tile joints water tight as specified in Section 07920, SEALANT AND CAULKING, around electrical outlets, piping fixtures and fittings before cover plates and escutcheons are set in place.
   6. Completed work shall be free from hollow sounding areas and loose, cracked or defective tile.
   7. Remove and reset tiles that are out of plane or misaligned.
   8. Floors:
      a. Extend floor tile beneath casework and equipment, except those units mounted in wall recesses.
      b. Align finish surface of new tile work flush with other and existing adjoining floor finish where shown.
      c. In areas where floor drains occur, slope to drains where shown.
      d. Shove and vibrate tiles over 8 inches square to achieve full support of bond coat.
   9. Walls:
      a. Cover walls and partitions, including pilasters, furred areas, and freestanding columns from floor to ceiling, or from floor to nominal wainscot heights shown with tile.
      b. Finish reveals of openings with tile, except where other finish materials are shown or specified.
      c. At window openings, provide tile stools and reveals, except where other finish materials are shown or specified.
      d. Finish wall surfaces behind and at sides of casework and equipment, except those units mounted in wall recesses, with same tile as scheduled for room proper.
   10. Joints:
      a. Keep all joints in line, straight, level, perpendicular and of even width unless shown otherwise.
      b. Make joints 1/16 inch wide for glazed wall tile and mosaic tile work.
      c. Make joints in paver tile, porcelain type; maximum 1/8 inch wide.
   11. Back Buttering: For installations indicated below, obtain 100 percent mortar coverage by complying with applicable special requirements for back buttering of tile in referenced ANSI A108 series of tile installation standards:
      a. Tile wall installations in wet areas, including showers, tub enclosures, laundries and swimming pools.
      b. Tile installed with chemical-resistant mortars and grouts.
      c. Tile wall installations composed of tiles 200 by 200 mm (8 by 8 inches or larger.
      d. Exterior tile wall installations.

3.06 CERAMIC TILE INSTALLED WITH PORTLAND CEMENT MORTAR

A. Mortar Mixes for Floor, Wall And Base Tile (including Showers): ANSI A108.1.except specified otherwise.

B. Installing Wall and Base Tile: ANSI A108.1, except specified otherwise.

C. Installing Floor Tile: ANSI A108.1, except as specified otherwise. Slope mortar beds to floor drains a minimum of 1/8 inch per foot.

3.07 PORCELAIN TILE INSTALLED WITH LATEX PORTLAND CEMENT BONDONG MORTAR

A. Due to the denseness of porcelain tile use latex Portland cement bonding mortar that meets the requirements of ANSI A118.4. Bonding mortars shall be mixed in accordance with manufacturer's instructions. Improper liquid ratios and dwell time before placement of bonding mortar and tile shall affect bond.

3.08 THIN SET CERAMIC AND PORCELAIN TILE INSTALLED WITH ORGANIC ADHESIVE

A. Installation of Tile: ANSI A108.4.

3.09 GROUTING

A. Grout Type and Location:
   1. Grout for glazed wall and base tile, paver tile and unglazed mosaic tile, use Portland cement grout, latex-Portland cement grout, dry-set grout, or commercial Portland cement grout.

B. Workmanship:
   1. Install and cure grout in accordance with the applicable standard.
   2. Portland Cement grout: ANSI A108.10.

3.10 MOVEMENT JOINTS

A. Prepare tile expansion, isolation, construction and contraction joints for installation of sealant. Refer to Section 07 92 00, JOINT SEALANTS.

B. TCA details EJ 171-02.

C. At expansion joints, rake out joint full depth of tile and setting bed and mortar bed. Do not cut waterproof or isolation membrane.

3.11 CLEANING

A. Thoroughly sponge and wash tile. Polish glazed surfaces with clean dry cloths.

B. Methods and materials used shall not damage or impair appearance of tile surfaces.

C. The use of acid or acid cleaners on glazed tile surfaces is prohibited.

D. Clean tile grouted with epoxy, furan and commercial Portland cement grout and tile set in elastomeric bond coat as recommended by the manufacturer of the grout and bond coat.

3.12 PROTECTION

A. Keep traffic off tile floor, until grout and setting material is firmly set and cured.

B. Where traffic occurs over tile floor, cover tile floor with not less than 3/8 inch thick plywood, wood particle board, or hardboard securely taped in place. Do not remove protective cover until time for final inspection. Clean tile of any tape, adhesive and stains.

C. Seal all tile 14 calendar days after grout has cured.

3.13 TESTING FINISH FLOOR

A. Test floors in accordance with ASTM C627 to show compliance with codes 1 through 10.

B. Provide 5% extra of each type of tile for future maintenance.

END OF SECTION

SECTION 09 51 01

ACOUSTICAL CEILINGS

PART 1 GENERAL

1.01 DESCRIPTION

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 1 – GENERAL REQUIREMENTS, which are hereby made a part of this Section of the Specifications.

1.02 RELATED WORK

A. Section 04 20 01, UNIT MASONRY.

B. Section 09 21 16, GYPSUM BOARD SYSTEM.

C. Section 13 34 19, PRE-ENGINEERED BUILDING.

1.03 SUBMITTALS

A. Submit in accordance with Section 01 33 00, SUBMITTALS.

B. Samples:
1. Acoustical units, each type, with label indicating conformance to specification requirements.
2. Colored pins or markers for units providing access.
3. Metal ceiling grid, main runners and cross tees, minimum 12" length.

C. Manufacturer's Literature and Data:
1. Ceiling suspension system, each type, showing complete details of installation.
2. Acoustical units, each type

D. Manufacturer's Certificates:
1. Acoustical units, each type, in accordance with specification requirements.

1.04 DEFINITIONS

A. Standard definitions as defined in ASTM C634.

B. Terminology as defined in ASTM E1264.

1.05 APPLICABLE PUBLICATION

A. The publications listed below form a part of this specification. The publications are referenced in the text by the basic designation only.

B. American Society for Testing and Materials (ASTM):

A641/A641M-03	Zinc-coated (Galvanized) Carbon Steel Wire
A653/A653M-07	Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-coated (Galvannealed) by the Hot-Dip Process
C423-07	Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method
C634-02 (E2007)	Standard Terminology Relating to Environmental Acoustics
C635-04	Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings
C636-06	Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels
E84-07	Surface Burning Characteristics of Building Materials
E119-07	Fire Tests of Building Construction and Materials
E413-04	Classification for Rating Sound Insulation.
E580-06	Application of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Requiring Seismic Restraint
E1264-(R2005)	Classification for Acoustical Ceiling Products

PART 2 PRODUCTS

2.01 METAL SUSPENSION SYSTEM

A. General:
   1. Lay-in Acoustical Ceiling Tile System:
      a. Manufacturer – "Donn Exposed Ceiling Suspension System (DX), Color to be Flat White.
      b. Exposed grid shall provide a minimum 5/16-inch panel bearing surface.
      c. Fabricate wall molding and other special molding from the same material with same exposed width and finish as the exposed grid members.
      d. Entire suspension system to be provided by single manufacturer.
      e. Color: White.

B. Main Runners:
   1. All main runners shall conform to ASTM C635, heavy-duty classification.

2. All main runners components shall be of double web design, measuring 1-1/2" high x 144" long and manufactured from electro-galvanized steel with a standard white, factory applied paint finish.
3. All main runner components shall be manufactured with a 15/16" exposed or concealed face which a pre-painted steel cap is affixed for exposed face.
4. All main runner components shall possess hangar holes and cross tee slots with spacing from manufacturer's standard product line.
5. All main runner components shall possess bayonet-style end coupling for quick and secure main runner connections.
6. Use same construction for cross runners as main runners. Use of lighter-duty sections for cross runners is not acceptable.

C. Cross Tee Components:
1. All cross tee components shall be of double web design measuring 1-1/2" high by 48" long and manufactured from elector-galvanized steel with standard white, factory applied paint finish.
2. All cross tee components shall be manufactured with a 15/16" exposed or concealed flange to which a pre-painted steel cap is affixed for the exposed face.
3. All cross tee components shall possess hangar holes and cross tee slots with spacing from manufacturer's standard product line.
4. All cross tee components shall posses a snap-grid coupling system for quick and secure installation. The coupling system shall also provide for tee removal, if necessary, without the need for special tools.

D. Perimeter Treatment:
1. Shadow Line (Stepped wall angle) - Shadow line moldings shall be manufactured from a minimum thickness of .020 elector-galvanized steel with a standard white, factory applied paint finish.

2.02 WIRE

A. ASTM A641.

B. For wire hangers: Minimum diameter 0.1055 inch.

C. For bracing wires: Minimum diameter 0.1350 inch.

2.03 ANCHORS AND INSERTS

A. Use anchors or inserts to support twice the loads imposed by hangers attached thereto.

B. Hanger Inserts:
1. Fabricate inserts from steel, zinc-coated (galvanized after fabrication).

2. Nailing type option for wood forms:
   a. Upper portion designed for anchorage in concrete and positioning lower portion below surface of concrete approximately 25 mm (one inch).
   b. Lower portion provided with not less than 8 mm (5/16 inch) hole to permit attachment of hangers.
3. Flush ceiling insert type:
   a. Designed to provide a shell covered opening over a wire loop to permit attachment of hangers and keep concrete out of insert recess.
   b. Insert opening inside shell approximately 5/8 inch wide by 3/8 inch high over top of wire.
   c. Wire 3/16 inch diameter with length to provide positive hooked anchorage in concrete.

C. Clips:
1. Galvanized steel.
2. Designed to clamp to steel beam or bar joists, or secure framing member together.
3. Designed to rigidly secure framing members together.
4. Designed to sustain twice the loads imposed by hangers or items supported.

2.04 ACOUSTICAL UNITS

A. Acoustical Ceiling Tile No. 1 (ACT 1): Acoustone "Glacier" by USG Corporation.
1. General:
   a. ASTM E1264, weighing 1.50 pounds per square foot minimum for lay-in panels.
   b. ASTM E84, Class A.
   c. Minimum NRC - 0.70 unless specified otherwise.
   d. Minimum CAC - 35 range unless specified otherwise.
   e. ASTM E1264, Type III Form-4, Pattern F (texture cast product with foilback and core color complementing the finish surface).
   f. Contractor shall use the same ceiling tile manufacturer's product (each type) throughout the Project area.
2. Type: Lay-in panels with angle tegular (shadow line, reveal) edges.
3. Color: White
4. Edge Treatment: Shadowline (SL)
5. Size: 24"x 24" x 3/4"
6. Location: All areas.

2.05 ACCESS IDENTIFICATION

A. Pins:
1. Provide pins with colored spherical head 3/16-inch in diameter and shaft of sufficient length to secure clip fastener captive on back of acoustical unit.

2. Provide a spring type captive clip or other fastener device that can easily be removed without damaging acoustical units or pins.

B. Markers:
1. In lieu of colored pins, colored markers with pressure sensitive adhesive on one side may be used with exposed grid suspension systems.
2. Make colored markers of paper or plastic, 1/4 to 3/8-inch in diameter.

C. Use pins or markers of the same diameter throughout each building.

D. Color code:
Use following colors on pins or markers for service identification:

Color	Service
Red	Sprinkler System: Valves and Controls
Green	Domestic Water: Valves and Controls
Yellow	Chilled Water and Heating Water
Orange	Ductwork: Fire Dampers
Blue	Ductwork: Dampers and Controls

PART 3 EXECUTION

3.01 CEILING TREATMENT

A. Lay out acoustical units symmetrically about center lines of each room, space, or panel unless shown otherwise on reflected ceiling plan.

B. Moldings:
1. Install metal wall molding at perimeter of each room, column space or panel, and at adjacent vertical surfaces.
2. Install special shaped molding at changes in ceiling heights and at other breaks in ceiling construction to support acoustical units and to conceal their edges.

3.02 CEILING SUSPENSION SYSTEM INSTALLATION

A. General:
1. Install metal suspension system for acoustical tile and lay-in panels in accordance with ASTM C636, except as specified otherwise.
2. Use direct or indirect hung suspension system or combination thereof as defined in ASTM C635.
3. Support a maximum area of 16 sf of ceiling per hanger.
4. Prevent deflection in excess of 1/360 of span of cross runner and main runner.
5. Provide extra hangers, minimum of one hanger at each corner of each item of mechanical, electrical and miscellaneous equipment supported by ceiling suspension system not having separate support or hangers.

6. Provide not less than 4 inch clearance from the exposed face of the acoustical units to the underside of ducts, pipe, conduit, secondary suspension channels, concrete beams or joists; and steel beam or bar joist unless furred system is shown,
7. Use main runners not less than 48 inches in length.
8. Install hanger wires vertically. Angled wires are not acceptable except for seismic restraint bracing wires.

B. Direct Hung Suspension System:
1. As illustrated in ASTM C635.
2. Support main runners by hanger wires attached directly to the structure overhead.
3. Maximum spacing of hangers, 4 feet on centers unless interference occurs by mechanical systems. Use indirect hung suspension system where not possible to maintain hanger spacing.

C. Indirect Hung Suspension System:
1. As illustrated in ASTM C635.
2. Space carrying channels for indirect hung suspension system not more than 4 feet on center. Space hangers for carrying channels not more than 8 feet on center or for carrying channels less than 4 feet or center so as to insure that specified requirements are not exceeded.
3. Support main runners by specially designed clips attached to carrying channels.

D. Seismic Ceiling Bracing System:
1. Construct system is accordance with ASTM E580.
2. Connect bracing wires to structure above as specified for anchorage to structure and to main runner or carrying channels of suspended ceiling at bottom.

3.03 ACOUSTICAL UNIT INSTALLATION

A. Cut acoustic units for perimeter borders and penetrations to fit tight against penetration for joint not concealed by molding.

B. Install lay-in acoustic panels in exposed grid with not less than 1/4-inch bearing at edges on supports.
1. Install tile to lay level and in full contact with exposed grid.
2. Replace cracked, broken, stained, dirty, or tile not cut for minimum bearing.
3. Trim all cut or partial acoustical units to maintain reveal edge.
4. Provide and install “hold down” clips at all tile panels.

C. Tile in concealed grid upward access suspension system:
1. Install acoustical tile with joints close, straight and true to line, and with exposed surfaces level and flush at joints.
2. Make corners and arises full, and without worn or broken places.
3. Locate acoustical units providing access as specified under Article ACCESS.

3.04 ACCESS

A. Locate acoustical units providing access to those components of concealed utilities systems which require periodic inspection, maintenance or operation such as valves, traps, coils, dampers, strainers, monitoring devices, switches and cleanouts.
   1. Determine number, size, and location of ceiling access units and panels after installation of various control items of mechanical and electrical work for which access is required.
   2. Minimum size of access units, 24 by 24-inch.
   3. See mechanical drawings for locations of access for duct work cleanouts and for locations of valves.

B. Identification:
   1. Identify acoustical units providing access to identify different services above acoustical units providing access. Contractor to field determine locations.
   2. Install pins or markers of color code specified to identify the various concealed piping, mechanical, and plumbing systems.
   3. Attach colored markers to exposed grid on opposite sides of the units providing access.
   4. Attach pins with color head visible on exposed ceiling surface of acoustical unit by piercing through unit and securing pin at back of unexposed top surface with fastener specified.

3.05 CLEAN-UP AND COMPLETION

A. Replace damaged, discolored, dirty, cracked and broken acoustical units.

B. Leave finished work free from defects.

3.06 MAINTENANCE SUPPLY

A. Provide Owner with four (4) full, unopened cases of ACT 1 for future maintenance and repair.

END OF SECTION

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SECTION 09 67 00

POLYMER FLOOR COATING

PART 1 - GENERAL

1.01 SUMMARY

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 1 – GENERAL REQUIREMENTS, which are hereby made a part of this Section of the Specifications.

B. This section specifies materials for a seamless, polymer floor coating system (epoxy), including surface preparation, primers and finish coats.

1.02 RELATED SECTIONS

A. Section 03 30 00, CAST IN PLACE CONCRETE.

B. Section 04 20 01, UNIT MASONRY.

C. Section 09 21 16, GYPSUM BOARD SYSTEM.

1.03 SYSTEM DESCRIPTION

A. The work shall consist of preparation of the substrate, the furnishing and application of an epoxy based multi roller applied flooring system with Micro or Macro colored decorative chips and urethane topcoat. The system shall have the color and texture as specified, with a nominal thickness of 40 mils. It shall be applied to the prepared area(s) as defined in the plans strictly in accordance with the Manufacturer's recommendations.

B. Cove base to be applied where noted on plans and per manufacturers standard details unless otherwise noted.

1.04 SUBMITTALS

A. Submit in accordance with Section 01 33 00, SUBMITTALS.

B. Product Data: Latest edition of Manufacturer's literature including performance data and installation procedures.

C. Manufacturer's Safety Data Sheet (SDS) for each product being used.

D. Samples: A 3 x 3 inch square sample of the proposed system. Color, texture, and thickness shall be representative of overall appearance of finished system subject to normal tolerances.

1.05 QUALITY ASSURANCE

A. The Manufacturer shall have a minimum of 10 years experience in the production, sales, and technical support of epoxy and urethane industrial flooring and related materials.

B. The Contractor shall have experience in installation of the flooring system as confirmed by the manufacturer in all phases of surface preparation and application of the product specified.

C. System shall be in compliance with requirements of United States Department of Agriculture (USDA), Food, Drug Administration (FDA), and local Health Department.

D. System shall be in compliance with the Indoor Air Quality requirements of California section 01350 as verified by a qualified independent testing laboratory.

1.01 DELIVERY, STORAGE AND HANDLING

A. Packing and Shipping:
   1. All components of the system shall be delivered to the site in the Manufacturer's packaging, clearly identified with the product type and batch number.

B. Storage and Protection:
   1. The area shall be between 60 F and 90 F, dry, out of direct sunlight and in accordance with the Manufacturer's recommendations and relevant health and safety regulations.
   2. Copies of Safety Data Sheets (SDS) for all components shall be kept on site for review by the Engineer or other personnel.

1.02 PROJECT/SITE CONDITIONS

A. Site Requirements:
   1. Application may proceed while air, material and substrate temperatures are between 60 F and 90 F providing the substrate temperature is above the dew point. Outside of this range, the Manufacturer shall be consulted.

2. The relative humidity in the specific location of the application shall be less than 85 % and the surface temperature shall be at least 5 F above the dew point.
3. The Contractor shall ensure that adequate ventilation is available for the work area.

B. Conditions of New Concrete to be Coated with Epoxy Material:
1. Concrete shall be moisture cured for a minimum of 7 days and have fully cured a minimum of twenty-eight days in accordance with ACI-308 prior to the application of the coating system pending moisture tests.
2. Concrete shall have a flat rubbed finish, float or light steel trowel finish (a hard steel trowel finish is neither necessary or desirable).
3. Sealers and curing agents should not to be used.
4. Concrete surfaces on grade shall have been constructed with a vapor barrier to protect against the effects of vapor transmission and possible delamination of the system.

C. Safety Requirements:
1. All open flames and spark-producing equipment shall be removed from the work area prior to commencement of application.
2. "No Smoking" signs shall be posted at the entrances to the work area.
3. Non-related personnel in the work area shall be kept to a minimum.

1.03 WARRANTY

A. Provide a one year warranty against defects in material and workmanship upon Substantial Completion of the Project.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Acceptable Manufacturer: Dur-A-Flex, Inc., 95 Goodwin Street, East Hartford CT, or approved equal.

2.02 FLOORING SYSTEM

A. Epoxy Flooring System Basis of Design: Dur-A-Flex, Dur-A-Chip, Epoxy-Based seamless flooring system:
1. System Materials:
a. Primer: Dur-A-Flex, Inc, Dur-A-Glaze #4 WB resin and hardener.
b. First Broadcast Coat: Dur-A-Flex, Inc, Dur-A-Gard OPF resin and hardener.
c. Second Broadcast and Grout Coat: Dur-A-Flex, Inc. Dur-A-Glaze #4 resin and Water Clear hardener.

d. Chips: Dur-A-Flex, Inc. Macro or Micro Decorative Colored Chips.
e. Topcoat: Dur-A-Flex, Inc. Armor Top resin, hardener and grit.

2. Patch Materials:
   a. Shallow Fill and Patching: Use Dur-A-Flex, Inc. Dur-A-Glaze #4 Cove Rez.
   b. Deep Fill and Sloping Material (over ¼ inch): Use Dur-A-Flex, Inc. Dur-A-Crete.
3. Color: System color to match Dur-A-Flex "Oystershell".

2.03 PRODUCT REQUIREMENTS

A. Primer, Dur-A-Glaze #4 WB:
1. Percent Solids: 56%
2. VOC: 2 g/L.
3. Bond Strength to Concrete ASTM D 4541: 55 psi, substrate fails.
4. Hardness, ASTM D 3363: 3H.
5. Elongation, ASTM D 2370: 9%.
6. Flexibility (1/4: Cylindrical mandrel), ASTM D 1737: Pass.
7. Impact Resistance, MIL D-2794: >160.
8. Abrasion Resistance ASTM D 4060, CS 17 wheel, 1,000 g Load: 30 mg loss.

B. Broadcast Coat, Dur-A-Gard OPF:
1. Percent Solids: 100%.
2. VOC: 59 g/L.
3. Compressive Strength, ASTM D 695: 16,000 psi.
4. Tensile Strength, ASTM D 638: 3,800 psi.
5. Flexural Strength, ASTM D 790: 4,000 psi.
6. Abrasion Resistance, ASTM D 4060 C-10 Wheel, 1,000 gm load, 1,000 cycles: 35 mg loss.
7. Flame Spread/NFPA-101, ASTM E 84: Class A.
8. Impact Resistance MIL D-3134: 0.025 inch Max.
9. Water Absorption. MIL D-3134: Pass.
10. Potlife @ 70 F: 20-25 minutes.

C. Broadcast Coat and Grout Coat, Dur-A-Glaze #4 Water Clear:
1. Percent Solids: 100%.
2. VOC: 3.8 g/L.
3. Compressive Strength, ASTM D 695: 11,200 psi.
4. Tensile Strength, ASTM D 638: 2,100 psi.
5. Flexural Strength, ASTM D 790: 5,100 psi.
6. Abrasion Resistance, ASTM D 4060 C-10 Wheel, 1,000 gm load, 1,000 cycles: 29 mg loss.
7. Flame Spread/NFPA-101, ASTM E 84: Class A.
8. Impact Resistance MIL D-24613: 0.0007 inches, no cracking or delaminations.
9. Water Absorption. MIL D-24613: Nil.
10. Potlife @ 70 F: 20 minutes.

D. Topcoat, ArmorTop:
   1. Percent Solids: 95%.
   2. VOC: 0 g/L.
   3. Tensile Strength, ASTM D 2370: 7,000 psi.
   4. Adhesion, ASTM 4541: Substrate Failure.
   5. Hardness, ASTM D 3363: 4H.
   6. 60^0 Gloss ASTM D 523: 70.
   7. Abrasion Resistance, ASTM D4060 CS 17 wheel (1,000 g load) 1,000 cycles:
      a. Gloss: 4 mg loss with grit, 10 mg loss without grit.
      b. Satin: 8 mg loss with grit, 12 mg loss without grit.
   8. Pot Life, 70 F, 50% RH: 2 hours.
   9. Full Chemical Resistance: 7 days.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas and conditions for compliance with requirements for maximum moisture content, installation tolerances and other conditions affecting flooring performance.
   1. Verify that substrates and conditions are satisfactory for flooring installation and comply with requirements specified.

3.02 PREPARATION

A. General:
   1. New and existing concrete surfaces shall be free of oil, grease, curing compounds, loose particles, moss, algae growth, laitance, friable matter, dirt, and bituminous products.
   2. Moisture Testing: Perform tests recommended by manufacturer and as follows.
      a. Perform relative humidity test using is situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75% relative humidity level measurement.
      b. If the relative humidity exceeds 75% then Dur-A-Flex, Inc Dur-A-Glaze MVP Primer moisture mitigation system must be installed prior to resinous flooring installation. Slab-on grade substrates without a vapor barrier may also require the moisture mitigation system.
   3. There shall be no visible moisture present on the surface at the time of application of the system. Compressed oil-free air and/or a light passing of a propane torch may be used to dry the substrate.
   4. Mechanical surface preparation.
      a. Shot blast all surfaces to receive flooring system with a mobile steel shot, dust recycling machine (Blastrac or equal). All surface and embedded

accumulations of paint, toppings hardened concrete layers, laitance, power trowel finishes and other similar surface characteristics shall be completely removed leaving a bare concrete surface having a minimum profile of CSP 3-4 as described by the International Concrete Repair Institute.

b. Floor areas inaccessible to the mobile blast machines shall be mechanically abraded to the same degree of cleanliness, soundness and profile using diamond grinders, needle guns, bush hammers, or other suitable equipment.
c. Where the perimeter of the substrate to be coated is not adjacent to a wall or curb, a minimum 1/4 inch key cut shall be made to properly seat the system, providing a smooth transition between areas. The detail cut shall also apply to drain perimeters and expansion joint edges.
d. Cracks and joints (non-moving) greater than 1/8 inch wide are to be chiseled or chipped-out and repaired per manufacturer's recommendations.

5. At spalled or worn areas, mechanically remove loose or delaminated concrete to a sound concrete and patch per manufactures recommendations.

3.03 APPLICATION

A. General:
1. The system shall be applied in six distinct steps as listed below:
   a. Substrate preparation.
   b. Priming.
   c. First broadcast coat application with first chip broadcast.
   d. Second broadcast coat with second chip broadcast.
   e. Grout coat application.
   f. Topcoat application.
2. Immediately prior to the application of any component of the system, the surface shall be dry and any remaining dust or loose particles shall be removed using a vacuum or clean, dry, oil-free compressed air.
3. The handling, mixing and addition of components shall be performed in a safe manner to achieve the desired results in accordance with the Manufacturer's recommendations.
4. The system shall follow the contour of the substrate unless pitching or other leveling work has been specified by the Architect.
5. A neat finish with well-defined boundaries and straight edges shall be provided by the Contractor.

B. Primer:
1. The primer shall be Dur-A-Glaze #4 WB Primer that is mixed at the ratio of 1 part resin to 4 parts hardener per the manufacturer's instructions.
2. The primer shall be applied by 1/8 inch notched squeegee and back rolled at the rate of 200 sf/gal to yield a dry film thickness of 4 mils.

C. Broadcast Coats:

1. The broadcast coat shall be applied as a double broadcast system as specified by the Architect.
2. The broadcast coat shall be comprised of two components, a resin, and hardener as supplied by the Manufacturer and mixed in the ratio of 2 parts resin to 1 part hardener.
3. The resin shall be added to the hardener and thoroughly mixed by suitably approved mechanical means.
4. The first broadcast coat shall be applied over horizontal surfaces using the dip and roll, and back roll method at the rate of 300 sf/gal using the Dur-A-Gard OPF material.
5. Chips shall be broadcast to excess into the wet material, Macro chips at the rate of 0.1 lbs/sf, and Micro chips at the rate of 0.15 lbs/sf.
6. Allow material to fully cure. Vacuum, sweep and/or blow to remove all loose aggregate.
7. Scrape the floor with a trowel or floor scraper. Sweep and vacuum the floor again.
8. Apply a second broadcast coat of resin shall be applied by flat squeegee then back rolled with a coverage rate of 200 sf/gal with the Dur-A-Glaze #4 Water Clear material.
9. Chips shall be broadcast to excess, Macro chips at the rate of 0.1 lbs/sf, and Micro chips at the rate of 0.15 lbs/sf.
10. Allow material to fully cure. Vacuum, sweep and/or blow to remove all loose chips.
11. Scrape the floor with a trowel or floor scraper. Sweep and vacuum the floor again.

D. Grout Coat:
   1. The grout coat shall be comprised of a Dur-A-Glaze # 4 Water Clear material that is mixed in the ratio of 1 part hardener to 2 parts resin and installed per the manufacturer's recommendations.
   2. The grout coat shall be squeegee applied and back rolled with a coverage rate of 150 sf/gal.

E. Topcoat:
   1. The topcoat of Armor Top shall be roller applied at the rate of 500 sf/gal to yield a dry film thickness of 3 mils.
   2. The finish floor will have a nominal thickness of 40 mils.

3.04 FIELD QUALITY CONTROL

A. Tests, Inspection:
   1. The following shall be conducted by the Contractor:
      a. Temperature:
         1) Air, substrate temperature and, if applicable, dew point.
      b. Coverage Rates:
         1) Rates for all layers shall be monitored by checking quantity of material used against the area covered.

3.05 CLEANING AND PROTECTION

A. Cure flooring material in compliance with manufacturer's directions, taking care to prevent their contamination during stages of application and prior to completion of the curing process.

B. Remove masking. Perform detail cleaning at floor termination, to leave cleanable surface for subsequent work of other sections.

END OF SECTION

SECTION 09 77 00

GLASS FIBER REINFORCED PLASTIC PANELING (FRP)

PART 1 GENERAL

1.01 DESCRIPTION

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 1 – GENERAL REQUIREMENTS, which are hereby made a part of this Section of the Specifications.

B. All work shall comply with all federal, state and local codes and any other authorities having jurisdiction.

C. Section Includes: Fiberglass Reinforced plastic (FRP) paneling for wall surfaces, including trim accessories

1.02 REFERENCES

A. General: Standards listed by reference form a part of this specification section. Standards listed are identified by issuing authority, abbreviation, designation number, title or other designation. Standards subsequently referenced in this Section are referred to by issuing authority abbreviation and standard designation.

B. ASTM International:

1. ASTM D2583 - Standard Test Method for Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor.

2. ASTM D5319 – Standard Specification for Glass-Fiber Reinforced Polyester Wall and Ceiling Panels.

3. ASTM D5420 - Standard Test Method for Impact Resistance of Flat, Rigid Plastic Specimen by Means of a Striker Impacted by a Falling Weight (Gardner Impact).

4. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

C. Factory Mutual FM:

1. FM Approval 4880 - Class 1 Fire Rating of Insulated Wall or Wall and Roof/Ceiling Panels, Interior Finish Materials or Coatings, and Exterior; Wall Systems.

1.03 SUBMITTALS

A. Submit in accordance with Section 01 33 00, SUBMITTALS

B. Shop Drawings: Showing layout, profiles and product components, including anchorage, accessories, finish colors, patterns and textures. Indicate location and dimension of joints and fastener attachment.

C. Samples: Selection and verification samples for finishes, colors and textures. Submit two samples of each type of panel, trim and fastener.

D. Certificates: Product certificates signed by manufacturer certifying materials comply with specified performance characteristics, criteria and physical requirements.

E. Test and Evaluation Reports: Showing compliance with specified performance characteristics and physical properties.

F. Manufacturer's Instructions: Manufacturer's Installation Guide for FRP #6876.

G. Qualifications Statements: For manufacturer and installer.

H. Operation and Maintenance Data: For installed products including maintenance methods and precautions against cleaning materials and methods detrimental to finishes and performance.

I. Warranty: Warranty documents required in this section.

1.04 DELIVERY, STORAGE AND HANDLING

A. Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact. Package sheets on skids or pallets for shipment to project site.

B. Storage and Handling: Store materials protected from exposure to harmful weather conditions and at temperature and humidity conditions recommended by manufacturer. Store panels in a dry indoor location at Project site. Remove any foreign matter from face of panel by using a soft bristle brush, avoiding abrasive action.

1.05 PROJECT CONDITIONS

A. Ambient Conditions:
   1. Do not begin installation until building is enclosed, permanent heating and cooling equipment is in operation, and residual moisture from plaster, concrete or terrazzo work has dissipated.

2. During installation, and within 48 hours prior to installation, maintain ambient temperature and relative humidity within limits required by type of panel adhesive used and recommendation of panel adhesive manufacturer.

1.06 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace FRP panels that fail within specified warranty period.
   1. Failures shall include, but not be limited to substantial defects in material and workmanship, rotting, rusting, corrosion, development of structural surface cracks, or requiring painting or refinishing.

   2. Warranty Period: Ten (10) years from date of Substantial Completion.

B. Special Warranty: Installer's standard form in which installer agrees to repair or replace FRP panels that fail due to poor workmanship or faulty installation within the specified warranty period.
   1. Warranty Period: Ten (10) years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 GENERAL

A. Low-Emitting Materials: Painting and coatings shall comply with the testing and product requirements of the California Department of Public Health's " Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small Scale Environmental Chambers."

2.02 FIBERGLASS REINFORCED PLASTIC PANELS (FRP)

A. Fiberglass reinforced plastic panels complying with ASTM D5319.

B. Manufacturer:
   1. Crane Composites, Inc., Glasbord Fiberglass Reinforced Plastic (FRP) Panels, Fire-X Glasbord Factory Mutual (FXE), or approved equal.

C. Product Options:
   1. Color: 85 Embossed White.

   2. Surface Finish: Pebbled embossed texture.

   3. Nominal Thickness: 0.09 inch (2.3 mm).

4. Wall Panel Size: 4 feet (1.2 m) by 12 feet.

5. Surface Protection: Manufacturer's proprietary molecularly-bonded surface protection film for fiberglass reinforced plastic (FRP) panels.

D. Performance Criteria:

1. Scratch Resistance: ASTM D2583, Barcol Hardness of 40.

2. Abrasion Resistance: Taber Abrasion Test using CS-17 abrasive wheels with 1000 g weight. Panels shall exhibit weight loss after 25 cycles of no more than 0.038 percent.

3. Impact Strength: ASTM D5420, 12 in-lb (0.64 J) showing no visible damage on finish side.

4. Product Identification: Finish side identification and confirmation of meeting interior finish requirements after installation and while in service, without labels.

2.03 ACCESSORIES

A. Moldings, Trim and Caps: One-piece extruded polypropylene and/or PVC, configured to cover panel top, bottom and side edges and corners.

1. Color: Match Panels.

B. Panel Adhesive: As recommended by panel manufacturer for the required substrates.

1. Crane Advance Polmer Adhesive

2. Adhesive shall have a VOC content of fifty (50) g/L or less.

C. Panel Seam Sealant: Bright white, two-part urethane sealant as recommended by FRP panel manufacturer.

1. Clean Room Recommended Urethane Sealant (A-Resin, C-Curative, two-part urethane sealant).

2. Sealant shall have a VOC content of 0.0 g/L.

D. Rivets: Color to Match Panels.

2.04 SOURCE QUALITY CONTROL

A. Obtain fiberglass reinforced panels, moldings and other accessories from a single manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

A. General: Comply with manufacturer's product data, including product technical bulletins, and installation instructions in product catalogs and product packaging.

B. Verify that substrates previously installed under other sections are acceptable for product installation in accordance with FRP manufacturer's instructions.

1. Examine substrate surfaces to determine that corners are plumb and straight, that surfaces are smooth, sound and uniform, that nails or screw fasteners are countersunk, and that joints and cracks are filled flush and smooth with adjoining surfaces.

2. Do not begin panel installation until substrate surfaces are in satisfactory condition.

3.02 PREPARATION

A. Clean substrates to remove substances that could impair bond of adhesive, including oil, grease, dirt, dust or other contamination.

B. Condition panels by unpacking and placing in installation space no less than 24 hours before installation.

C. Lay out paneling before beginning installation. Locate panel joints to provide equal panel widths at ends of walls and so that trimmed panels at corners are not less than 12 inches (300 mm) wide.

3.03 INSTALLATION

A. General: Comply with panel manufacturer's installation guide #6876. Follow guidelines set forth in regards to installation in high humidity rooms.

B. Cut and drill panels with carbide tipped saw blades or drill bits, or cut with snips.

C. Install panels with manufacturer's recommended gap for panel field and corner joints.

1. Pre-drill fastener holes in panels, 1/8 inch (3.2 mm) greater in diameter than fastener.

2. Install panels in a full spread of adhesive. For trowel type and application of adhesive, follow adhesive manufacturer's recommendations.

D. Install trim accessories with adhesive and nails or staples. Do not fasten through panels.

E. Sealant:

1. Fill grooves in trim accessories with sealant before installing panels and bed inside corner trim in a bead of sealant.

2. Remove excess sealant and smears as paneling is installed. Clean with solvent recommended by sealant manufacturer and then wipe with clean dry cloths.

3.04 PROTECTION

A. Protect installed product and finish surfaces from damage during construction.

END OF SECTION

SECTION 09 90 00
Painting

(Filed Sub-Bid)

1.1 DESCRIPTION

A All of the Contract Documents, including General and Supplementary conditions and Division 0 – Bidding Documents, Contract Forms and Conditions of the Contract and Division 1 – General Requirements, apply to the work in this Section.

B Carefully examine all the Contract Documents for requirements which affect the work of this Section. The exact scope of this Section cannot be determined without a thorough review of all specifications sections and other Contract Documents.

C Where referred to, Standard Specifications, Recommendations of Technical Societies, and/or Manufacturer's Associations, plus Codes of Federal, State, and Local Agencies shall include all amendments current as of date of issue of these specifications.

1.2 REQUIREMENTS FOR SUBMITTING FILED SUB-BID

A. Sub-bids shall be submitted for the Work of this Section in accordance with the provisions of M.G.L. c.149 §§44A-J The time and place for submission of sub-bids are set forth in the **Advertisement.** The procedures and requirements for submitting sub-bids are set forth in the **Instructions to Bidders.**

B. Sub-bidders must be DCAMM Certified in the listed trade and shall include a Current DCAMM sub-bidder Certificate of Eligibility and a signed DCAMM Sub-bidder’s Update Statement with the bid

C. Specification requirements for the Filed Sub-bid "Painting" include all of the following listed Specification Sections in their entirety.

SECTION 09 90 10 - PAINTING

D. The Work of this Section is shown on Drawings
TS-001, R-101, R-102, A-001, A-002, A-003, A-101, A-102, A-104, A-201, A-202, A-301, A-302, A-401, A-402, A-403, A-404, A-405, A-501, A-502, A-503,

A-504, A-505, A-506, A-507, A-508, A-509, A-601, A-701, A-801, A-802, FP-101, FP-102, FP-201

E. SUB-SUBS

1. Sub-sub bids are required for this Section. Sub-Bidders shall include the appropriate information for the list of sub sub-bid Class of Work noted below in this paragraph. NOT APPLICABLE

2. If the Filed Sub-Bidder customarily performs the above Work with its own workforce, the Sub-Bidder should list its own name and trade and leave the dollar amount blank.

3. If the Filed Sub-Bidder does not customarily perform the Classes of Work with its own workforce, the Sub-Bidder should list the name of the contractor performing the work, the trade and insert a dollar amount.

END OF SECTION

SECTION 09 90 10

PAINTING
(Filed Sub Bid Required as Part of Section 09 90 00)

PART 1 GENERAL

1.01 DESCRIPTION

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 1 – GENERAL REQUIREMENTS, which are hereby made a part of this Section of the Specifications.

B. This section specifies paint as applied in the building.

C. **Work in this Section is included as part of the work in Section 09 90 00.**

1.02 RELATED WORK

A. Section 04 20 01, UNIT MASONRY.

B. Section 05 50 00, METAL FABRICATIONS.

C. Section 05 51 00, METAL STAIRS.

C. Section 08 11 00, STEEL DOORS AND FRAMES.

D. Section 06 20 00, FINISH CARPENTRY AND MILLWORK.

E. Section 09 21 16, GYPSUM BOARD SYSTEM.

F. Section 13 34 19, PRE-ENGINEERED BUILDING.

G. Section 21 00 01, FIRE PROTECTION.

1.03 SUBMITTALS

A. Submit in accordance with Section 01 33 00, SUBMITTALS.

B. Manufacturer's Literature and Data: Before work is started submit manufacturer's literature, indicating brand names, product type color, gloss level, coating composition, Federal Specification Number or manufacturers name or product number where applicable, and certificates as specified.

C. Sample of identity markers if used.

D. Manufacturers' Certificates indicating compliance with specified requirements:
1. Manufacturer's paint used in lieu of Federal Specification paints meets or exceeds the performance of the specified paint.

1.04 DELIVERY, AND STORAGE

A. Deliver materials to the site in the manufacturer's sealed container marked to show the following:
1. Name of manufacturer
2. Product type
3. Batch number
4. Instructions for use
5. Safety precautions

B. In addition to the manufacturer's label, each container shall bear a label upon which is legibly printed the following:
1. Federal Specification Number, where applicable, and name of material.
2. Surface upon which material is to be applied.
3. If paint or other coating, the coat (prime, body or finish) for which it is to be used.

C. Maintain space for storage, and handling of painting materials and equipment in a neat and orderly condition and to prevent spontaneous combustion from occurring or igniting adjacent items.

D. Store materials at the site at least 24 hours before using, at a temperature between 65 and 85 degrees F.

1.05 MOCK-UP PANEL

A. Before starting application of water paint mixtures and apply the paint as specified to an area, not to exceed 100 square feet, selected by the Architect.

B. Finish and texture approved by the Architect will be used as a standard of quality for the remainder of the work.

1.06 APPLICABLE PUBLICATIONS

A. Publications listed below form a part of this specification. Publications are referenced in the text by basic designation only.

B. Federal Specifications (Fed. Spec.):

TT-C-535B(2).....Coating, Epoxy, Two Component, For Interior Use On Metal, Wood, Wallboard, Painted Surfaces, Concrete And Masonry
TT-C-542E.....Coating, Polyurethane, Oil Free, Moisture Curing
TT-E-489H.....Enamel, Alkyd, Gloss Low VOC Content
TT-E-506K.....Enamel, Alkyd, Gloss, Tints And White (For Interior Use)
TT-E-508C.....Enamel, Interior, Semigloss, Tints And White
TT-E-545C.....Primer, (Enamel, Undercoat Alkyd Odorless, Interior, Flat, Tints And White)
TT-F-322D.....Filler, Two-Component Type, For Dents, Cracks, Small-Holes And Blow-Holes
INT AMD 1
TT-F-340C.....Filler, Wood, Plastic
TT-F-1098D.....Filler Block, Solvent-Thinned, for Porous Surfaces (Concrete Block, Cinder Block, Stucco Etc.)
TT-P-19D.....Paint Latex (Acrylic Emulsion, Exterior Wood And Masonry)
TT-P025E(2).....Primer, Coating, Exterior Undercoat For Wood, Ready-Mixed, White And Tints
TT-P-26C(1).....Paint, Interior, White, Tints And Black, Fire Retardant
TT-P-28G.....Paint, Aluminum, Heat Resisting (1200 Deg. F)
TT-P-29J.....Paint, Latex
INT AMD 2
TT-P-30E(1).....Paint, Alkyd, Odorless, Interior, Flat, White And Tints
TT-P-96D(2).....Paint, Latex-Base, For Exterior Surfaces (White And Tints)
TT-P-102E.....Paint, Oil (Alkyd Modified, Exterior, Low VOC)
INT AMD 1
TT-P-641G(1).....Primer Coating, Zinc Dust-Zinc Oxide (For Galvanized Surfaces)
TT-P-645B.....Primer, Paint, Zinc-Molybdate, Alkyd Type
TT-P-650D.....Primer Coating, Latex Base, Interior, White (For Gypsum Wallboard, or Plaster)
TT-P-664D.....Primer Coating, Alkyd, Corrosion-Inhibiting, Lead And Chromate Free, VOC-Complaint
TT-P-1511B.....Paint, Latex (Gloss And Semigloss, Tints And White) (For Interior Use)
TT-P-2119.....Paint, Latex-Base, High Traffic Area, Flat And Eggshell Finish, (Low Lustre), (For Interior Use)
TT-S-176E(1).....Sealer, Surface, Varnish Type, Floor, Wood And Cork
TT-S-179B(1).....Sealer, Surface, Pigmented Oil, For Plaster And Wallboard
TT-S-711C.....Stain, Oil Type, Wood, Interior

C. Commercial Item Description (CID):

A-A-1272.....Plaster, Gypsum (Spackling Compound)
A-A-1555.....Water Paint, Powder (Cementitious, White and Colors)
A-A-2210.....Filler, Wood Paste

D. Western Wood Products Association (WWPA):
Research Note No. 312- Revised 30, 1985.....Painting Over Knots

E. Steel Structures Painting Council (SSPC):
SP 1-89.....No. 1, Solvent Cleaning
SP 2-89.....No. 2, Hand Tool Cleaning
SP 3-89.....No. 3, Power Tool Cleaning

F. Military Specifications (Mil. Spec.):
MIL-P-21035B.....Paint, High Zinc Dust Content, Galvanizing, Repair

G. American National Standards Institute (ANSI):
ANSI-A13.1-81.....Scheme for the Identification of Piping Systems

H. American Society for Testing and Materials (ASTM):
D260….....Boiled Linseed Oil

PART 2 PRODUCTS

2.01 MATERIALS

A. See paint schedule in paragraph 3.11 in this Section.

2.02 PAINT PROPERTIES

A. Use ready-mixed (including colors), except two component polyesters, paints having metallic powders packaged separately and paints requiring specified additives.

B. Materials finely ground, uniform in consistency and readily dispersed to form a smooth and homogeneous fluid.

C. Where no requirements are given in the referenced specifications for primers, use primers with pigment and vehicle, compatible with substrate and finish coats specified.

PART 3 EXECUTION

3.01 JOB CONDITIONS

A. Safety: Observe all required safety regulations and the manufacturer's warning and instructions for storage, handling and application of painting materials.
   1. Take necessary precautions to protect personnel and property from hazards due to falls, injuries, toxic fumes, fire explosion, or other harm.
   2. Deposit soiled cleaning rags and waste materials in metal containers approved for that purpose. Dispose of such items off the site at the end of each days work.

B. Atmospheric and Surface Conditions:
   1. Do no exterior or interior painting in foggy, damp or rainy weather. When building is completely enclosed, interior work may be painted.
   2. Paint exterior and interior surfaces when the ambient temperature is between 50 and 90 degrees F, except when otherwise designated in the manufacturer's printed instructions. Maintain interior temperatures until the paint dries hard.
   3. Do no exterior painting when it is windy and dusty.
   4. Do no painting in direct sunlight or on surfaces which will soon be warmed by the sun.
   5. Apply only on clean, dry and frost free surfaces except as follows:
      a. Apply water thinned acrylic and cementitious paints to damp (not wet) surfaces where allowed by the manufacturer's printed instructions.
      b. Dampened with a fine mist of water on hot, dry days concrete and masonry surfaces to which water thinned acrylic and cementitious paints are applied to prevent excessive suction and to cool the surface.

3.02 SURFACE PREPARATION

A. General:
   1. Remove prefinished items not to be painted such as lighting fixtures, escutcheon plates, hardware, trim, and similar items for reinstallation after paint is dried.
   2. Remove items for reinstallation and complete painting of such items and adjacent areas when item or adjacent surface is not accessible or finish is different.
   3. See other sections of specifications for specified surface conditions and prime coat.
   4. Clean surfaces for painting with materials and methods compatible with the substrate and specified finish. Remove any residue remaining from cleaning agents used. Do not use solvents, acid, or steam on concrete and masonry.
   5. Method of surface preparation is optional, provided results of finish painting produce solid even color and texture specified with no overlays.

B. Wood:
   1. Sand to a smooth even surface and then dust off.
   2. Sand surfaces showing raised grain smooth between each coat.
   3. Wipe surface with a tack rag prior to applying finish.
   4. Surface to be painted with an opaque finish:
      a. Coat knots, sap and pitch streaks with knot sealer before applying paint.
      b. Apply two coats of knot sealer over large knots.

5. After application of prime or first coat of stain, fill cracks, nail and screw holes, depressions and similar defects with plastic wood or putty compound. Use plastic wood for transparent finish, to match wood. Sand to make smooth and finish flush with adjacent surface.
6. Before applying finish coat, reapply plastic wood or putty compound if required, and sand surface to remove surface blemishes. Finish flush with adjacent surfaces.
7. Fill open grained wood such as oak, walnut, ash and mahogany with a paste wood filler, colored to match wood color.
   a. Thin filler in accordance with manufacturer's instructions for application.
   b. Remove excess filler, wipe as clean as possible, allow to dry and sand as specified.

C. Ferrous Metals:
1. Remove oil, grease, soil, drawing and cutting compounds, flux and other detrimental foreign matter by use of solvents, emulsions, cleaning compounds, or by steam cleaning, as defined in SSPC-SP 1.
2. Remove loose mill scale, rust, and paint, by hand or power tool cleaning, as defined in SSPC-SP 2 and SSPC-SP 3, except where high temperature aluminum paint is used, prepare surface in accordance with the paint manufacturer's instructions.
3. Fill dents, holes and similar voids and depressions in flat exposed surfaces of hollow steel doors and frames, access panels, roll-up steel doors and similar items specified to have semi-gloss or gloss finish with metal filler compound. Finish flush with adjacent surfaces.
4. Spot prime abraded and damaged areas in shop prime coat which expose the bare metal, with same type of paint used for prime coat. Feather edge of spot prime to produce smooth finish coat.
5. Spot prime abraded and damaged areas which expose the bare metal of factory finished items with paint as recommended by the manufacturer.

D. Zinc-Coated (Galvanized) Metal, Aluminum, Copper and Copper Alloys Surfaces Specified painted:
1. Clean surfaces to remove grease, oil and other deterrents to paint adhesion, with toluene, xylene or similar solvents in accordance with SSPC-SP 1.
2. Spot coat abraded and damaged areas of zinc-coating which expose the base metal, using zinc rich paint MIL Spec MIL -P-21035, on hot-dip zinc-coated items and spot prime with zinc dust primer, Fed Spec. TT-P-641.

E. Gypsum Board and Plaster:
1. Remove efflorescence, loose and chalking plaster or finishing materials.
2. Remove dust, dirt, and other deterrents to paint adhesion.
3. Fill holes, cracks, and other depressions with spackling compound CID-A-A-1555 finished flush with adjacent surface, with texture to match texture of adjacent surface. Patch holes over one inch in diameter as specified in Section for plaster or gypsum board.

3.03 PAINT PREPARATION

A. Thoroughly mix painting materials to ensure uniformity of color, complete dispersion of pigment and uniform composition.

B. Do not thin unless necessary for application and when finish paint is used for body and prime coats. Use materials and quantities for thinning as specified in manufacturer's printed instructions.

C. Remove paint skins, then strain paint through commercial paint strainer to remove lumps and other particles.

D. Mix two component and two part paint and those requiring additives in such a manner as to uniformly blend as specified in manufacturer's printed instructions unless specified otherwise.

E. For tinting required to produce exact shades specified, use color pigment recommended by the paint manufacturer.

3.04 APPLICATION

A. Start of surface preparation or painting will be construed as acceptance of the surface as satisfactory for the application of materials.

B. Unless otherwise specified, apply paint in three coats; prime, body, and finish. When two coats applied to prime coat are the same, first coat applied over the primer is the body coat and second coat is the finish coat.

C. Apply each coat evenly and cover substrate completely.

D. Allow not less than 48 hours between application of succeeding coats, except as allowed by the manufacturer's printed instructions, and approved by the Architect

E. Finish surfaces to show solid even color, free from runs, lumps, brushmarks, laps, holidays, or other defects.

F. Apply by brush, roller or spray, except as otherwise specified.

G. Do not paint in the closed position operable items such as access doors and panels, window sashes, overhead doors, and similar items except overhead roll-up doors and shutters.

3.05 PRIME PAINTING

A. After surface preparation prime surfaces before application of body and finish coats, except as otherwise specified.

B. Spot prime and apply body coat to damaged and abraded painted surfaces before applying succeeding coats.

C. Additional field applied prime coats over shop or factory applied prime coats are not required, except for exterior steel apply an additional prime coat.

D. Prime rabbets and revels for stop and face glazing of wood, and for face glazing of steel.

E. Wood and Wood Particleboard:
1. Use same kind of primer specified for exposed face surface.
   a. Exterior wood: Wood oil base primer except where wood stain scheduled.
   b. Interior wood except for transparent finish: Enamel primer, thinned if recommended by the manufacturer.
   c. Transparent finishes as specified under Transparent Finishes Wood Except Floors.
2. Apply two coats of primer or sealer to surfaces of wood doors, including top and bottom edges, which are cut for fitting or for other reason.
3. Apply one coat of primer as soon as delivered to the site to surfaces of unfinished woodwork, except concealed surfaces of shop fabricated or assembled millwork and surfaces specified to have varnish, stain or natural finish.
4. Back prime and seal ends of exterior woodwork, and edges of exterior plywood specified to be finished.

F. Metals except boilers, incinerator stacks, and engine exhaust pipes:
1. Steel and iron: Ferrous metal primer. Use epoxy coating where finish of epoxy coating is specified.
2. Zinc-coated steel and iron: Zinc dust primer.
3. Aluminum scheduled to be painted: Zinc molybdate primer.
4. Copper and copper alloys scheduled to be painted: Zinc molybdate primer.
5. Machinery not factory finished: Enamel, Alkyd, Gloss Low VOC content.

G. Gypsum Board and Plaster:
1. Surfaces scheduled to receive vinyl coated fabric wallcovering: Use enamel primer and undercoat.
2. Pigmented sealer, except use latex emulsion for alkyd flat finish.
3. Surfaces scheduled to have acrylic emulsion or latex emulsion finish: Use acrylic emulsion or latex emulsion respectively.
4. Use epoxy coating for surfaces scheduled to receive epoxy coating finish.

H. Concrete Masonry Units except glazed or integrally colored and decorative units:

1. Concrete Masonry Unit Filler on interior surfaces.
2. Prime exterior surface as specified for exterior finishes.

I. Barrier coat to separate epoxy paint from existing oil or alkyd paint:
1. Two coats latex emulsion or rubber paint.

3.06 FINISHES

A. Apply following finish coats over prime coats in spaces or on surfaces specified.

B. Metal Work:
1. Apply to exposed surfaces.
2. Omit body and finish coats on surfaces concealed after installation.
3. Ferrous Metal, Galvanized Metal, and Other Metals Scheduled:
   a. Apply two coats of Alkyd Gloss (G) unless specified otherwise.

C. Gypsum and Plaster:
1. One coat of enamel undercoat plus one coat of low-luster (LL).
2. Two coats of latex eggshell (EG).
3. One coat of enamel undercoat plus two coats of latex semigloss (SG).

D. Masonry and Concrete Walls:
1. Over filler on CMU surfaces.
2. Two coats of latex emulsion (LE).
3. Two coats of latex flat (AK), low-luster (LL), latex semigloss (SG), or latex gloss (LG).

E. Wood:
1. Sanding:
   a. Use 220 grit sandpaper.
   b. Sand Sealers and lacquer between coats.
   c. Sand enough to scarify the surface to assure good adhesion of the subsequent coats, to level roughly applied sealer and varnish, and to knock off the "whiskers" of any raised grain as well as dust particles.
2. Sealers:
   a. Apply sealers specified except sealer may be omitted where pigmented, penetrating, or wiping stains containing resins are used.
   b. Allow manufacturer's recommended drying time before sanding, but not less than 24 hours or 36 hours in damp or muggy weather.
   c. Sand as specified.

3.07 REFINISHING EXISTING PAINTED SURFACES

A. Clean, patch and repair existing surfaces as specified under surface preparation.

B. Remove and reinstall items as specified under surface preparation.

C. Remove existing finishes or apply separation coats to prevent non compatible coatings from having contact.

D. Patched or Replaced Areas in Surfaces and Components: Apply spot prime and body coats as specified for new work to repaired areas or replaced components.

E. Except where scheduled for complete painting apply finish coat over plane surface to nearest break in the plane. (i.e., corner, reveal, or frame.)

F. In existing rooms and areas where alterations occur, clean existing stained and natural finished wood retouch abraded surfaces and then give entire surface one coat of varnish.

G. Refinish areas as specified for new work to match adjoining work unless specified or scheduled otherwise.

H. Coat knots and pitch streaks showing through old finish with knot sealer before refinishing.

I. Sand or dull glossy surfaces prior to painting.

J. Sand existing coatings to a feather edge so that transition between new and existing finish will not show in the finished work.

3.08 PAINT COLOR

A. Coat Colors:
1. Color of priming coat shall be lighter than body coat.
2. Color of body coat shall be lighter than finish coat.
3. Color prime and body coats as required so as to not show through the finish coat and to mask surface imperfections or contrasts.
4. Color to be selected by Architect from manufacturer’s standard color.
5. Color of sprinkler piping to be painted shall be “Safety Red”.

3.09 FIELD PAINTING SCHEDULE

A. Mechanical and Electrical:
1. Field painting of mechanical and electrical work, consists of cleaning, touching-up abraded shop prime coats, and applying prime, body and finish coats to materials and equipment which are exposed to view in the completed work as specified.

B. Work to be Painted: Building and Structural and Fire Protection.

1. Painting and finishing of interior and exterior work except as specified under Paragraph work not to be painted.
2. Painting and finishing of new and existing work including colors and gloss of finish as specified.
3. Painting of disturbed, damaged and repaired or patched surfaces when entire space is not scheduled for complete repainting or refinishing.
4. Panting of ferrous metal and galvanized metal.
5. Painting of wood.
6. Sprinkler system iron and steel parts.

C. Work not to be painted:
1. Prefinished items:
   a. Casework, doors, elevator entrances and cabs, metal panels, wall covering, and similar items specified factory finished under other sections.
   b. Factory finished equipment and pre-engineered metal building components.
2. Finished surfaces:
   a. Hardware except ferrous metal.
   b. Anodized aluminum, stainless steel, chromium plating, copper, and brass, except as otherwise specified.
   c. Signs, fixtures, and other similar items integrally finished.
3. Concealed surfaces:
   a. Inside dumbwaiter, elevator and duct shafts, pipe basements, crawl spaces, pipe tunnels, above ceilings, attics, except as otherwise specified.
   b. Inside walls or other spaces behind access doors or panels.
   c. Surfaces concealed behind permanently installed casework and equipment.
   4. Moving and operating parts:
   a. Shafts, chains, gears, mechanical and operators, linkages, sprinkler heads, electrical parts such as valve stems, sensing devices.
   b. Tracks for overhead or coiling doors.
5. Labels:
   a. Code required label, such as Underwriters Laboratories Inc., Warnock Hersey, or Factory Mutual Research Corporation.
   b. Identification plates, instruction plates, performance rating, and nomenclature.
6. Metal safety treads and nosings.
7. Sealants and Gaskets.
8. Air handling units.
9. Concrete curbs, gutters, pavements, retaining walls, exterior exposed foundations walls and interior walls in pipe basements.
10. Face brick.
11. Structural steel encased in concrete, masonry, or other enclosure.
12. Ceilings walls, columns, and structural steel in interstitial spaces.
13. Sprinkler heads, bronze or brass fittings, other corrosion resistant materials and moving parts.

3.10 PROTECTION CLEAN UP, AND TOUCH-UP

A. Protect all work from paint droppings and spattering by use of masking, drop cloths, removal of items or by other approved methods.

B. Upon completion, clean paint from hardware, glass and other surfaces and items not required to be painted of paint drops or smears.

C. Before final inspection, touch-up or refinished in a manner to produce solid even color and finish texture, free from defects work which as become damaged or discolored.

3.11 PAINT SCHEDULE

A. Acceptable Manufacturers: Sherwin William Company or approved equal. Note: Color match by an approved equal is acceptable.

B. Gypsum and Plaster:
   1. Latex Enamel Flat Finish – Ceilings:
      a. Two coats over primer with total DFT mi. 2.0 mils.
      b. Primer - White, Interior, Latex-Based Primer: Sherwin Williams PrepRite 200 (B28W200).
      c. First and Second Coats - Interior, Flat, Latex-Based Paint; Sherwin Williams ProMar® 200 Interior Latex Flat (B30-200).
   2. Semi-Gloss Emulsion (Opaque) Finish - Walls:
      a. Two coats over primer with total DFT mi. 2.0 mils.
      b. Primer - White or Tint at Dark Colors, Interior, Latex-Based Primer: Sherwin Williams PrepRite 200 (B28W200).
      c. First and Second Coat - Interior, Semi-gloss, Latex-Based Paint: Sherwin Williams ProMar® 200 (B31-2200).

C. Concrete and Masonry:
   1. Semi-Gloss Emulsion (Opaque) Finish - Walls:
      a. Two coats over primer with total DFT mi. 2.0 mils.
      b. Primer - White, Interior, Acrylic Resin Surfacer: Sherwin Williams Loxon® Block Surfacer (A24W200)
      c. First and Second Coat - Interior, Semi-gloss, Latex-Based Paint: Sherwin Williams ProMar® 200 (B31-2200).

D. Woodwork:
   1. Gloss Enamel (Opaque) Finish - Interior Woodwork:
      a. Two coats over undercoater.
      b. Undercoat - Interior Acrylic Primer Sealer: Sherwin Williams PrepRite® Interior Latex Primer (B28W101).
      c. First and Second Coat – Interior, Gloss Enamel, Alkyd-Based Paint: Sherwin Williams ProMar® 200 Interior Alkyd Gloss Enamel (B35).

d. Sand wood surfaces smooth between coats.

2. Transparent Finish - Millwork:
   a. Two coats lacquer over sealer.
   b. Sealer - M.L. Campbell Magnalac Pre-Catalysed Lacquer #C144-14 Satin or M.L. Campbell Vinyl Sealer C101-83.
   c. Two Coats Lacquer - M.L. Campbell Magnalac Pre-Catalysed Lacquer.
   d. Prepare wood between coats as recommended by manufacturer.

E. Ferrous Metal:
   1. Semigloss Enamel (Opaque) Finish:
      a. Two finish coat over primer with total DFT min. 2.5 mils.
      b. Primer – Alkyd Metal Primer: Sherwin Williams Kem Kromik® Universal Metal Primer (B500Z) – low VOC.
      c. Finish Coat - Gloss, Alkyd Enamel: Sherwin Williams Industrial Enamel (B54Z) – low VOC.

F. Zinc-Coated Metal:
   1. Semigloss Enamel (Opaque) Finish:
      a. Two finish coats over primer with total DFT min. 2.5 mils.
      b. Primer – Solvent Based-Acrylic Primer: Galvite™ HS (B50WZ30) – low VOC.
      c. Finish Coat - Gloss, Alkyd Enamel: Sherwin Williams Industrial Enamel (B54Z) – low VOC.

END OF SECTION

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SECTION 10 14 00

HANDICAP ACCESSIBLE INTERIOR SIGNAGE

PART 1 - GENERAL

1.01 DESCRIPTION

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 1 - GENERAL REQUIREMENTS, which are hereby made a part of this Section of the Specifications.

B. This section specifies handicap accessible interior signage for permanent room numbers, rest room identification, code required signs, telephone identification signs, etc.

C. All handicap accessible signage shall comply with the Massachusetts Architectural Access Barriers Regulations (521 CMR) and the Americans with Disabilities Act (ADA).

1.02 SUBMITTALS

A. Submit in accordance with Section 01 33 00, SUBMITTALS.

B. Product literature:
1. Preparation instructions and recommendations.
2. Storage and handling requirements and recommendations.
3. Materials, fabrication, finishing, fastenings, hardware, and accessories.
4. Mounting details and installation methods.

C. Shop drawings:
1. Extents of installation, room sizes, layouts, profiles, signage dimensions, penetrations if any, control dimensions and architectural alignments.
2. Interface with building services and adjacent construction.
3. Material thicknesses and joints, anchorage, trim, hardware and locks, finishes, substrate materials, and accessories.
4. Base building requirements, and installation procedures.
5. Identify typography, artwork, finishes, message locations and similar.
6. Coordinate nomenclature and terminology with sign drawings, message schedule, and location plan.

D. Certificates: Product certificates signed by the manufacturer certifying materials comply with specified performance characteristics, physical requirements, and project specific requirements.

E. Samples:
   1. Selection Samples: Provide manufacturers standard samples for selection of finishes, colors, and textures.
   2. Submit one full size sample of each type, style, and color including method of attachment. Accepted samples may be incorporated into finished work.

1.03 QUALITY ASSURANCE

A. Single Source Responsibility: Except as noted below, all materials and components shall be fabricated by a single manufacturer including mounting hardware and materials, fittings, fastenings, lighting, electronics, finished surfaces and concealed internal supports.

B. Manufacturer Qualifications: Minimum 10 years or more experience in fabrication of solid phenolic materials, experienced in performing work of similar size and scope, and with production facilities to meet the project schedule.

C. Installer Qualifications: Specialized in performing signage work, with minimum 2 years experience installing similar products.

D. Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship and finishes.
   1. Finish areas designated by Architect.
   2. Do not proceed with remaining work until workmanship is approved by Architect.
   3. Refinish mock-up area as required to produce acceptable work.
   4. Accepted mock-up may be incorporated into the finished work and shall establish the standard of workmanship and acceptance for remaining work.

1.04 DELIVERY, STORAGE AND HANDLING

A. Ordering: Comply with manufacturer's ordering instructions and lead time requirements to avoid construction delays.

B. Do not deliver signs until facility is enclosed and conditioned within temperature and humidity ranges expected of final occupancy.

C. Deliver and store products in manufacturer's original, unopened packaging bearing the brand name and manufacturer's identification until ready for installation.
   1. Package and label signs in groups indicated on the drawings.
   2. Prevent contact with materials or project conditions that may cause corrosion, discoloration, or staining.

3. Store signage materials in a safe, dry, above ground location until mounting surfaces are ready for installation.
4. Protect from damage from other trades.

D. Handling: Handle materials to avoid damage.

PART 2 - PRODUCTS

2.01 MANUFACTURER

A. Basis of Design: 2/90 Sign Systems, which is located at: 5350 Corporate Grove Blvd. S.E.; Grand Rapids, MI 49512, or approved equal.

2.02 MATERIALS

A. Aluminum: Manufacturer's standard 6063-T6/T5 or 6061-T6 alloy.

B. Interior Panel Substrate: Acrylic.

C. Interior Sign Insert Material:
   1. ABS Inserts:
      a. Composition: 0.090 inch (2.2 mm) extruded ABS plastic core with 0.003 inch (0.07 mm) UV resistant acrylic cap bonded during extrusion/texturing process.
      b. Fixing Accessories: Pressure bonded to extruded PVC hook using high-bond, pressure sensitive adhesive.
      c. Color: Integral color or painted in acrylic lacquer as specified with signs.
      d. Protective Coating: Chromium industries #HM335RA texture pattern to prevent glare and disguise fingerprints.
   2. ADA, Integral Tactile Inserts:
      a. Composition: Graphics and Insert materials are one piece. Tactile Photopolymer Inserts are 0.080 inch (2 mm) phenolic photopolymer with raised copy etched to 0.032 inch (0.8 mm).
      b. Fixing Accessories: Pressure bonded to extruded PVC hooks with adhesive.
      c. Colors: Background is painted in acrylic lacquer in the specified Insert color. Top surface of copy characters is then added by roller printing in the specified copy color using Silkscreen inks.

D. Interior Graphics Types:
   1. Direct Print: VOC free, ultra-violet cured inks digitally applied directly to the substrate surface.
   2. Silkscreen: Lacquer-based Silkscreen inks.
   3. Braille: As indicated with ADA materials above.

E. Standard Sign Sizes:
   1. The standard sign sizes shall be as follows unless otherwise specified.
      a) Room numbers (up to 4 numbers) - 6 inches wide (min.) by 3-1/2 inches high.
      b) Pictogram signs - 6 inches wide by 9 inches high.
      c) Pictogram signs for stairs and fire safety - 8 inches wide by 9 inches high.

F. Character Proportion:
   1. Letters and numbers on signs shall have a width-to-height ratio between 3:5 and 1:1, and a stroke-width-to-height ratio between 1:5 and 1:10.

G. Character Height:
   1. Characters and numbers on signs shall be sized according to the viewing distance from which they are to be read.
   2. The minimum height is three inches and is measured using an upper case X.
   3. Lower case characters are permitted.

2.03 INTERIOR SIGN SYSTEMS

A. Basis of Design: Modular Sign System, by 2/90 Sign Systems or approved equal.
   1. Components: Structural rails, copy inserts, and interlocking end caps. Capable of being arranged in a variety of configurations with minimum of attachments, devices and connectors.
   a. Structural Rails: Extruded 6063-T5 aluminum anodized black to accept various insert materials and mounting devices, able to be converted in the field to add height or width. Rail Joiners are extruded black PVC plastic connecting structural rails together with a butt joint along the edge, not visible in the final assembly. Provide the following rail profiles.
      1) Standard Profile Rails: 9/16 inch (14.28 mm) thick with inserts both sides.
   b. Sign Size: As shown on Drawings.
   c. Inserts: Slide horizontally onto rails.
      1) Insert Color: To match 2/90 Sign Systems #708 "Soft White" and #734 "Dark Gray".
   d. End Caps: Extruded 6063-T5 aluminum or injection molded ABS interlock to structural rails with steel spring clips to form an integral unit, and secure changeable copy inserts without requiring tools for assembly. May be joined with other system signs of equal heights. Square corners.
   e. Top and Bottom Trim: Extruded 6063-T5 aluminum butts flush to copy inserts and encloses top or bottom structural rail and copy insert.

2.04 FABRICATION

A. Assemble units to the greatest extent possible in the fabrication shop to minimum onsite splicing or assembly.

1. Ensure welds are behind finished surfaces and will not transmit distortion or discoloration to finished surfaces.
2. Joints, miters and connections shall be tight and free of fractures.
3. Extruded members to be free from extrusion marks. Square turns and corners sharp, curves true.
4. Fasteners shall be concealed unless specifically shown on the drawings.
5. Form work to required shapes and sizes, with true curves, lines and angles. Provide necessary rebates, lugs and brackets for assembly.
6. Exposed ends and edges mill smooth, with corners slightly rounded.

B. Components shall allow for expansion and contraction for a minimum material temperature range of 56 degrees C (100 degrees F), without causing buckling, excessive opening of joints or over stressing of adhesives and fasteners.

C. Plane surfaces should be smooth, flat and without oil-canning, free of rack and twist. Restore texture to filled or cut areas.
   1. Maximum variation from plane of surface plus or minus 0.032 inch (0.8 mm).

D. Painted surfaces shall be primed in accordance with the paint manufacturers instructions. Finish coating of paint to have complete coverage with no light or thin applications that show substrate or primer. Finished surface smooth, free of scratches, gouges, drips, bubbles, thickness variations, foreign matter and other imperfections.

E. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for re-assembly and coordinated installation as indicated on the drawings.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.
   1. Verify areas are finished and ready to receive signage.
   2. Verify location of cast-in anchors, mounting hardware, concrete foundations or similar supports are properly installed, in the proper locations, and of the type and size required for each type of sign.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
C. Do not begin installation until unacceptable conditions are corrected.

3.02 PREPARATION

A. Clean surfaces thoroughly prior to installation.

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

C. Protect adjacent work and finished surfaces from damage during installation.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions, including product technical bulletins, product catalog installation instructions, and product carton installation instructions.

B. Locate as indicated on the drawings, sign location plan, and in accordance with approved shop drawings.

C. Avoid warps, buckles, distortion, opening joints, or overstressing welds or fasteners.

D. General:
1. All permanent rooms and spaces shall have a handicap accessible interior sign.
2. Permanent rooms accessible to the general public or building residents shall include toilet rooms, room (unit/apartment) numbers, exits, stairs, elevators, fire safety, mechanical rooms, utility closets, community rooms, permanent offices, etc. Note: Signs are not required within individual offices unless accessible to the general public.
3. Other signs that provide direction to, or information about, functional spaces of the building shall have handicap accessible interior signage.
4. Install all signs plumb and level.

E. Volume Control Telephones:
1. Telephones required to have a volume control shall be identified by a sign containing a depiction of a telephone handset with radiating sound waves.

F. Text Telephones (TTY):
1. Required text telephones shall be identified by the international TTY symbol.
2. If a facility has a public text telephone, directional signage indicating the location of the nearest text telephone shall be placed adjacent to all banks of telephones that do not contain text telephone. Such directional signage shall include the international TTY symbol.
3. If a facility has no banks of telephones but a public text telephone is available, the directional signage shall be provided at the entrance.

G. Assistive Listening Systems:

1. In assembly areas where permanently installed assistive listening systems are required, the availability of such systems shall be identified with signage that includes the international symbol of access for hearing loss.

H. Mounting Location and Height:
   1. Where permanent identification is required for rooms and spaces, signs shall be installed on the wall adjacent to the latch side of the door.
   2. Where there is no wall space to the latch side of the door, including double leaf doors, signs shall be placed on the nearest adjacent wall.
   3. Mounting location shall allow a person to approach within three inches of signage without encountering protruding objects or standing within the swing of a doors.
   4. Mounting height shall be 60 inches above the finish floor to the centerline of the sign.

I. Fasteners:
   1. Use concealed mechanical fastening devices such as toggle bolts in hollow cavity areas or screws in plugs or expanding wall anchors in solid masonry or concrete surfaces. Otherwise and where appropriate, an adhesive method of securement is acceptable.

K. Schedule: The following schedule provides the general messages for each space in the building. New signage shall be installed at all floors on all doors (new or existing) within the scope of work. Note: Include a three digit numeral for each sign in addition to the sign message. Numbering to be determined.

Location	Message
101	Vestibule
102	Meeting/Records
103	Office
104	Manager’s Office
106	Public Restroom
107	Women’s Restroom
108	Men’s Restroom
110	Corridor
111	Break Room
112	Uniforms
113	Janitors Closet
114	I.T. Closet
115	Electric Room
117	Shops
118	Storage
119	Storage
120	Office
121	Boiler Room
122	Restroom

123	Tool Room/Parts
124	Vehicle Repair Garage
125	Vehicle Garage
M02	Emergency Electric Closet
M03	BDA Closet

3.04 CLEANING

A. Remove temporary coverings and protection of adjacent work areas.

B. Clean installed products in accordance with manufacturer's instructions prior to owner's acceptance. Wipe clean with water-dampened cloth. Do not use chemicals or solvents.

C. Remove construction debris from project site and legally dispose of debris.

D. Clean all exposed surfaces in accordance with the manufacturer instructions.

3.05 PROTECTION

A. Protect installed products until completion of project.

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

END OF SECTION

SECTION 10 21 00

TOILET PARTITIONS

PART 1 GENERAL

1.01 DESCRIPTION

A. The Conditions of the Contract and Division 1, General Requirements shall be part of this section.

B. This section specifies floor mounted plastic toilet partitions and wall hung urinal screens.

1.02 SUBMITTALS

A. Submit in accordance with Section 01 33 00, SUBMITTALS.

B. Manufacturer's Literature and Data:
Specified items indicating all hardware and fittings, material, finish, and latching.

C. Shop Drawings: Construction details at 1/2 scale, showing installation details, anchoring and leveling devices.

D. Manufacturer's certificate, attesting that product conforms to specified requirements.

1.03 APPLICABLE PUBLICATIONS

A. Publications listed below form a part of this specification. Publications are referenced in the text by the basic designation only.

B. Federal Specifications (Fed. Spec.):
FF-B-575C.....Bolt, Hexagon and Square
FF-B-588(1).....Built, Toggle; And Expansion Sleeve Screw
FF-S-325.....Shield, Expansion; Nail, Expansion; And Nail
INT AMD 3 Drive Screw (Devices, Anchoring, Masonry)
RR-P-1352C.....Partitions, Toilet, Complete

PART 2 PRODUCTS

2.01 FABRICATION

A. Conform to Fed. Spec. RR-P-1352, except as modified herein.

B. Fabricate to dimensions shown or specified.

C. Toilet Partitions:
1. Materials:
   a. Density: ASTM D 1505, .96+ g/cc
   b. Tensile Yield: ASTM D 638, 4400 psi
   c. Elongation: ASTM D 638, >600 %
   d. Izod Impact: D 256, 7.0 ft-lb/in of notch
   e. Brittleness Temperature: ASTM D 746, < - 76°C
   f. Hardness: D 2240, 68 Shore D
   g. Flexural Modulus: ASTM D-256, 220.000 psi
   h. Self Ignition: ASTM D 1929-77, 700° F
   i. Rate of Burn: ASTM D635-81, 1.29 cm/min
   j. Smoke Density: ASTM D 2843, <25
   k. Warranty: 15 years
2. Panels, doors and Wall Posts: One inch finished thickness, high-density polyethylene. Doors shall be minimum 28 inch wide.
3. Stiles: One inch finished thickness; high-density polyethylene.
4. Leveling devices: 3/8" x 1" steel bar welded to steel reinforcing core of stile, forming a single structural unit; furnished with 3/8" diameter threaded rods, nuts, washers, sleeve-anchors and shoe retainer. Shoe shall be solid high-density plastic; 4 inches high. Wall bracket shall be continuous solid high-density plastic.
5. Headrail shall be heavy aluminum extrusion (6463-T5Alloy) with bright-dipped anodized finish in anti-grip configuration weighing not less than 1.188 lbs. per linear foot. Headrail shall be fastened to tops of pilasters and headrail brackets by thru-bolting with star-head security pin, stainless steel barrel bolts (no cadmium plated bolts allowed). Head rail brackets shall be 18 gauge stainless steel.
6. Hardware: Door latches, door keepers, coat hook and mounting brackets shall be constructed of 18-8, type 304, heavy-duty gauge stainless steel with satin finish. Threaded inserts are factory installed for securing hinges on out swinging doors. T-nuts shall be factory installed for securing door latch. Theft resistant, stainless steel one-way screws shall be furnished for all door hardware. Stainless steel Phillips-head screws shall be furnished for all mounting brackets. Hinge shall be integral to panels. Toilet compartment door shall be locked by **no-sight** strike system latch into keeper. Door keeper shall prevent out-swinging doors from swinging beyond stile.
7. Color: Panel color shall be #240 “Colonial”.
8. Manufacturer: General Partitions Mgf. Corp. floor-mounted overhead braced HDPE toilet compartments or approved equal.

2.02 FASTENERS

A. Partition Fasteners: FS RR-P-1362.

B. Use expansion bolts, FS FF-S-325, for anchoring to solid masonry or concrete.

C. Use toggle bolts, FS FF-B-588, for anchoring to hollow masonry or stud framed walls.

D. Use steel bolts FS-B-575, for anchoring pilasters to overhead steel supports.

E. Use lag bolts or tamper-resistant screws for anchoring to wood supports.

PART 3 EXECUTION

3.01 INSTALLATION

A. General:
1. Install in rigid manner, straight, plumb and with all horizontal lines level.
2. Conceal evidence of drilling, cutting and fitting in finish work.
3. Use sex-bolts for through-bolting.
4. Adjust hardware and leave in freely working order.
5. Clean finished surfaces and leave free of imperfections.

B. Panels and Pilasters:
1. Support panels, except urinal screens, and pilaster abutting building walls near top and bottom by stirrup supports secured to partitions with through-bolts.
2. Secure stirrups to walls with suitable anchoring devices for each stirrup.
3. Secure panels to faces of pilaster near top and bottom with stirrup supports, through-bolted to panels and machine screwed to each pilaster.
4. Secure edges of panels to edges of pilasters near top and bottom with "U" shaped brackets.
5. Where overhead braced, secure pilasters to building walls by headrails clamped on or set into top of each pilaster.
   a. Secure clamps to pilasters with two through-bolts to each clamp.
   b. When headrails are set into pilasters, through-bolt them to the pilasters.
   c. Support headrails on wall flange fittings secured to building walls with minimum of two anchor bolts to each flange fitting.

C. Install doors per manufacturer's recommendations and instructions.

END OF SECTION

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SECTION 10 28 00

TOILET AND BATH ACCESSORIES

PART 1 - GENERAL

1.01 SUMMARY

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 1 – GENERAL REQUIREMENTS, which are hereby made a part of this Section of the Specifications.

B. Section Includes:
1. Soap dispensers.
2. Combination towel dispenser and waste receptacle units.
3. Sanitary napkin disposal units.
4. Mirrors.
5. Shower rods and curtains.
6. Folding shower seat.
7. Grab bars.
8. Surface mounted multi-roll toilet tissue dispensers.
9. Hooks.

1.02 RELATED SECTIONS

A. Section 04 20 01, UNIT MASONRY.

B. Section 06 10 00, ROUGH CARPENTRY.

C. Section 09 21 16, GYPSUM BOARD SYSTEM.

D. Section 09 22 00, NON-LOAD BEARING FRAMING SYSTEMS.

E. Section 09 30 10, TILING.

1.03 SUBMITTALS

A. Submit in accordance with Section 01 33 00, SUBMITTALS.

B. Product Data: Submit manufacturer’s data sheets for each product specified, including the following:
1. Installations instructions and recommendations.
2. Storage and handling requirements and recommendations.
3. Cleaning and maintenance instructions.

4. Replacement parts information.

C. Schedule: Submit a toilet accessory schedule, indicating the type and quantity to be installed in each washroom. Use room numbers as indicated on the Drawings.

1.04 QUALITY ASSURANCE

A. Manufacturer: Provide products manufactured by a company with a minimum of 10 years successful experience manufacturing similar products.

B. Single Source Requirements: Provide products from a single manufacturer.

C. Accessibility Requirements: Comply with requirements of 521 CMR and ADA.

1.05 DELIVERY, STORAGE AND HANDLING

A. Deliver, store and handle materials and products in strict compliance with manufacturer's instructions and recommendations. Protect from damage.

PART 2 - PRODUCTS

2.01 MANUFACTURER

A. Acceptable Manufacturer: Bobrick Washroom Equipment Inc., or approved equal.

2.02 SOAP DISPENSERS

A. Surface Mounted Vertical Soap Dispensers:
   1. Basis of Design: Bobrick Classic Model B-2111.
   2. Compliance: Valve is operable with one hand, without tight grasping, pinching or twisting of the wrist with less than 5 pounds of force to comply with barrier-free accessibility guidelines (including ADAAG).
   3. Container:
   4. Valve: Corrosion-resistant, black molded plastic push button and spout, antibacterial-soap-resistant plastic cylinder; soap head-holding mushroom valve, stainless steel spring, U-packing seal and duckbill.
   5. Mounting: Vandal-resistant, concealed wall plate; back plate with mounting bracket.
   6. Filling: Locked, hinged stainless steel lid for top filling opens with key provided. To prevent corrosion of tank, use only chloride-free pH-neutral liquid soaps.
   7. Refill Indication: Clear acrylic refill-indicator window.
   8. Capacity: 40 fl oz.

2.03 COMBINATION TOWEL DISPENSER AND WASTE RECEPTACLE UNITS

A. Surface Mounted Paper Towel Dispenser and Waste Receptacle (Restroom 120):
   1. Basis of Design: Bobrick Model B-43699 with Bobrick 369-130 TowelMate and Brobrick 4369-134 LinerMate.
   2. Cabinet: All-welded, 18-8, Type 304, 22 gauge stainless steel with satin finish on exposed surfaces.
   3. Flange: Drawn, one-piece, seamless, 18-8, Type 304, 22 gauge stainless steel with satin finish. Flange corners and edges shall have radii that complement arc on front of door.
   4. Door: Drawn, one-piece, seamless, 18-8, Type 304, 22 gauge stainless steel with satin finish; with flush tumbler lock keyed like other washroom accessories.
   5. Hinge: Full-length stainless steel piano hinge.
   6. Skirt: 18-8, Type 304, 22 gauge (0.8mm) stainless steel with satin finish. Skirt corners shall have radii that complement arc on front of unit.
   7. Towel Dispenser: 18-8, Type 304, 22 gauge stainless steel with satin finish, cabinet inside equipped with 90 degree return towel guide angle.
   8. Towel Dispensing: Hemmed towel tray opening dispenses towels without tearing.
   9. Towel Capacity: 350 C-fold or 475 multifold towels.
   10. Waste Receptacle: Formed, one-piece, seamless, 18-8, Type 304, 22 gauge stainless steel with satin finish, hemmed top edge hemmed; secured to cabinet with two keyholes over studs on bottom and two tamper-resistant setscrews on top. Front of unit shall have same degree of arc.
   11. Waste Capacity: 3.0 gallons.

B. Semi-Recessed Paper Towel Dispenser and Waste Receptacle:
   1. Basis of Design: Bobrick Model B-43944 with Bobrick 3944-130 TowelMate and Brobrick 43944-134 LinerMate.
   2. Cabinet: All-welded, 18-8, Type 304, 22 gauge stainless steel with satin finish on exposed surfaces.
   3. Flange: Drawn, one-piece, seamless, 18-8, Type 304, 22 gauge stainless steel with satin finish. Flange corners and edges shall have radii that complement arc on front of door.
   4. Door: Drawn, one-piece, seamless, 18-8, Type 304, 22 gauge stainless steel with satin finish; with flush tumbler lock keyed like other washroom accessories.
   5. Hinge: Full-length stainless steel piano hinge.
   6. Towel Dispenser: 18-8, Type 304, 22 gauge stainless steel with satin finish, cabinet inside equipped with 90 degree return towel guide angle.
   7. Towel Dispensing: Hemmed towel tray opening dispenses towels without tearing.
   8. Towel Capacity: 600 C-fold or 800 multifold towels.
   9. Waste Receptacle: Formed, one-piece, seamless, 18-8, Type 304, 22 gauge stainless steel with satin finish, hemmed top edge hemmed; secured to cabinet with two keyholes over studs on bottom and two tamper-resistant setscrews on top. Front of unit shall have same degree of arc.

10. Waste Capacity: 15.0 gallons.

2.04 SANITARY NAPKIN DISPOSAL UNITS

A. Surface-Mounted Sanitary Napkin Disposal Units:
   1. Basis of Design: Bobrick ConturaSeries Model B-270.
   2. Container: All-welded, 18-8, Type 304, 22 gauge stainless steel with satin finish on exposed surfaces.
   3. Cover: Drawn, one-piece, seamless, 18-8, Type 304, 22 gauge stainless steel with satin finish.
   4. Hinge: Full length stainless steel piano-hinge.

2.05 MIRRORS

A. Stainless Steel Channel Frame Mirrors:
   1. Basis of Design: Bobrick Model B-165 1836.
      a. Overall Size: 18 inches by 36 inches.
   2. Channel Frame: One-piece, Type 304 stainless steel channel-frame, ½ inch by ½ inch by 3/8 inch, with 90 degree mitered corners; bright polished finish on exposed surfaces.
   3. Mirror: No. 1 quality, ¼ inch float glass, guaranteed for 15 years against silver spoilage.
      a. Corners: Protected by friction-absorbing filler strips.
      b. Back of Mirror: Protected full-size, shock absorbing, water-resistant, nonabrasive, 3/16 inch thick polyethylene padding.
   4. Mounting: Removable, galvanized steel back with integral horizontal hanging brackets, located at top and bottom for mounting on concealed rectangular wall hanger; locking devices secure mirror to concealed wall hanger.
   5. Wall Hanger: Concealed, 20 gauge galvanized steel; incorporates lower support member to engage lower backplate louvers to keep bottom of mirror against wall.

2.06 SHOWER RODS AND CURTAINS

A. Shower Curtain Hooks:
   1. Basis of Design: Bobrick Model 204-1.
   2. Materials: 18-8, Type 304, 0.09 inch diameter stainless steel.
   3. Operation: Can be used with 1 inch and 1-1/4 inch diameter rods.

B. Vinyl Shower Curtains:
   1. Basis of Design: Bobrick Model B-204-2.
   2. Curtain: Opaque, matte white, 0.008 inch thick vinyl containing antibacterial and flame-retardant agents; hemmed at bottom and sides.
   3. Grommets: Nickel-plated brass, along top edge every 6 inches.

4. Height: 72 inches.

C. Shower Curtain Rods:
1. Basis of Design: Bobrick Model 6047.
a. Length: As required, field verify.
2. Curtain Rod: 18-8, Type 304, 18 gauge stainless steel tubing with satin finish.
3. Outside Diameter: 1-1/4 inches.
4. Flanges: One-piece, die-formed, 18-8, Type 304, 20 gauge stainless steel with satin finish.

2.07 FOLDING SHOWER SEATS

A. Folding Shower Seats with Padded Cushion:
1. Basis of Design: Bobrick Model B517 and B-518.
a. Configuration: To be coordinated by Contractor.
2. Compliance: Universal/accessibility design, including ADA-ABA and ICC/ANSI. For structural strength; clearance between back of shower and wall is 1-1/2 inches.
a. Capacity: Designed to support 360 lbs. in compliant installations.
3. Seat: 2 inches overall thickness, comprised of 1-1/2 inch thick, closed-cell polyurethane foam padding mounted on ½ inch thick plywood; covered in white Naugahyde (water-resistant, reinforced vinyl fabric). Folds against wall when not in use.
4. Seat Supports: Do not come in contact with floor.
5. Frame: 18-8, Type 304 stainless steel with satin finish; 16 gauge, 1-1/4 inch square members, 18 gauge, 1 inch diameter tubing.
6. Mounting Flanges: 18-8, Type 304, 3/16 inch thick stainless steel with satin finish; 3 inch diameter with three mounting screw holes.
7. Baseplate: 18-8, Type 304, heavy gauge stainless steel.
8. Spring: 17-7, Type 301, 24 gauge stainless steel, spot-welded to backplate. Holds seat against wall.
9. Guide Bracket: 18-8, Type 304, 16 gauge stainless steel with satin finish.

2.08 GRAB BARS

A. Stainless Steel Grab Bars:
1. Basis of Design: Bobrick Model B-5806.99.
a. Length: Provide length as indicated on Drawings.
2. Compliance: Barrier-free accessibility guidelines (including ADAAG) for structural strength.
a. Capacity: Designed to support 900 lbs in compliant installations.
3. Description: Clearance between grab bar and finished wall is 1-1/2 inches.
4. Grab Bar Materials: 18-8, Type 304, stainless steel tubing with satin finish. Peended gripping surface.
5. Grab Bar Construction: 18 gauge, ends heliarc welded to flanges.

6. Outside Diameter: 1-1/4 inches.
7. Mounting Flanges: Concealed, 18-8 S, Type 304, 1/8 inch thick, stainless steel plate.
   a. End Flanges: 2 inches by 3-1/8 inches with two holes for attachment to wall.
   b. Intermediate Flanges: 2-5/8 inches by 3-1/8 inches wide by 3-1/8 inch diameter.
8. Snap Flange Covers: 18-8 S, Type 304, 22 gauge drawn stainless steel with satin finish, 3-1/4 inch diameter by 5/8 inches deep; snap over mounting flange to conceal mounting screws.

2.09 TOILET TISSUE DISPENSERS

A. Surface Mounted Multi-Roll Toilet Tissue Dispenser:
   1. Basis of Design: Bobrick Model B-2888.
   2. Cabinet: 18-8, Type 304, 22 gauge stainless steel. All-welded construction; with satin finish on exposed surfaces.
   3. Door: Front of door is drawn, one-piece, seamless, 18-8, Type 304, 22 gauge stainless steel, 18 gauge door frame, secured to cabinet with two rivets; with satin finish on exposed surfaces and equipped with a tumbler lock keyed like other washroom accessories.
   4. Dispensing Mechanism, Inner Housing and Cam: 18-8, Type 304, 18 gauge stainless steel.
   5. Spindles: Theft-resistant, heavy-duty, one-piece, molded ABS plastic; retained in dispensing mechanism when door is locked.
   6. Toilet Tissue Dispensing: Unit holds two standard-core toilet tissue rolls up to 5-1/4 inches in diameter. Roll held in reserve automatically drops into place after bottom roll is depleted. Depleted rolls can only be removed after unlocking door.

2.10 HOOKS

A. Coat Hooks:
   1. Basis of Design: Bobrick Model B-6717.
      a. Finish: Satin.
      b. Configuration: Single hook.
   2. Projection from Wall: 2 inches.
   3. Flange and Support Arm: All-welded, 18-8, Type 304, 22 gauge stainless steel.
   4. Mounting: Concealed bracket, 18-8, Type 304, 16 gauge stainless steel; secured to wall plate with stainless steel set screw.
   5. Wall Plates: Concealed, 18-8, Type 304, 16 gauge stainless steel.
   6. Caps: 18-8, Type 304, 10 gauge stainless steel; welded to support arm.

B. Robe Hooks:
   1. Basis of Design: Bobrick Model B-6827.
      a. Finish: Satin.

2. Projection from Walls: 3-1/16 inches.
3. Flange and Support Arm: 18-8, Type 304, 22 gauge stainless steel.
4. Mounting: Concealed bracket, all-welded, 16 gauge stainless steel; secured to wall plate with a stainless steel setscrew.
5. Wall Plates: Concealed, 18-8, Type 304, 16 gauge stainless steel.
6. Hooks: 18-8, Type 304, 12 gauge stainless steel, welded to support arm.

2.11 FASTENERS

A. Exposed Fasteners: Stainless steel or chromium plated brass, finish to match adjacent surface.

B. Concealed Fasteners: Steel, hot-dip galvanized (except in high moisture areas such as showers or bath tubs, use stainless steel).

C. Toggle Bolts: For use in hollow masonry or frame construction.

D. Sex Bolts: For through bolting on thin panels.

E. Expansion Shields: Lead or plastic as recommended by accessory manufacturer for component and substrate, for use in solid masonry or concrete.

PART 3 - EXECUTION

3.01 PREPARATION

A. Prior to starting work, notify the Architect in writing of any conflicts detrimental to installation or operation of units.

B. Verify with the Architect the exact location of accessories.

C. The mounting height and location of accessories in handicap accessible toilet rooms and bathrooms shall be located where shown on Drawings and comply with the more stringent requirements of 521 CMR and ADA.

D. Provide solid wood blocking behind all bathroom accessories.

3.02 INSTALLATION

A. Install products in strict compliance with manufacturer’s written instructions and recommendations, including the following:
   1. Verify blocking has been installed properly.

2. Verify location does not interfere with door swings or use of fixtures.
3. Comply with manufacturer's recommendations for backing and proper support.
4. Use fasteners and anchors suitable for substrate and project conditions.
5. Install units rigid, straight, plumb, and level, in accordance with manufacturer's installation instructions and approved shop drawings.
6. Conceal evidence of drilling, cutting, and fitting to room finish.
7. Test for proper operation.

3.03 CLEANING AND PROTECTION

A. Clean exposed surfaces of compartments, hardware, and fittings.

B. Touch-up, repair or replace damaged products.

END OF SECTION

SECTION 10 35 00

FLAGPOLES

PART 1 - GENERAL

1.01 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 1 - GENERAL REQUIREMENTS, which are hereby made a part of this Section of the Specifications.

1.02 DESCRIPTION OF WORK

A. Work Included: Provide labor, materials and equipment to complete the work of this Section including, but not limited to the following:
1. Fixed high dimensional, ground set, uniform conical taper, seamless tube flagpole.

B. Related Work: The following items are not included in this Section and will be performed under the designated Sections:
1. Excavation and backfill: SECTION 31 20 00, EARTHMOVING.
2. Concrete for ground set flagpole: SECTION 03 30 00, CAST-IN-PLACE CONCRETE.

1.03 SUBMITTALS

A. Submit in accordance with SECTION 01 33 00 - SUBMITTALS.

B. Shop Drawings:
1. Flagpole, including base and finial ball, showing construction and installation.
2. Manufacturer shall specify size and depth of base for flagpole. Note: Contractor to include cost of concrete base in bid, no extra will be permitted.

C. Product Data:
1. Flagpole

1.04 REFERENCE STANDARDS

A. Publications listed below form a part of this specification. The publications are referenced in the text by the basic designation only.

B. American Society for Testing and Materials (ASTM):
A167 ……..… Stainless and Heat-resisting Chromium-Nickel Steel

Revision A Plate, Sheet and Strip
B209 …….. Aluminum and Aluminum Alloy-Sheet and Plate
B241/B241M …..... Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube

PART 2 - PRODUCTS

2.01 MATERIALS

A. Aluminum, Extruded: ASTM B241, alloy 6063 - T6.

2.02 FABRICATION

A. Fabricate flagpole of seamless extruded aluminum tube, uniform conical taper of approximately one inch in every 5.5 feet. Taper shall not exceed 50 percent of outside diameter of pole. When flagpoles are shipped in more than one section, provide self-aligning sleeves for field joint. Pole shall have an exposed height of 25'-0".

B. Base: Aluminum plate or stainless steel, of stock design similar to that shown.

C. Finial Ball: .0747 inch thick spun aluminum sphere, with seams of ball welded flush and watertight. Mount ball on threaded rod to fit truck. Diameter of ball shall be approximately same as pole butt diameter.

D. Truck: Equip pole with extra heavy, internal revolving, non-fouling, ball bearing type truck with cast aluminum body. Fit truck with two cast aluminum, nylon bushed sheaves on stainless steel axles.

E. Internal Halyards: Highly flexible stainless steel cable routed through the internal flagpole shaft.
1. The cable is to attach to a gearless positive locking winch that allows the flag at any position on the pole.
2. Cable shall be routed over two pulleys inside the revolving truck and ends with a neoprene ball block to prevent jamming at the pole top.
3. Provide solid neoprene ball retaining loop with stainless steel aircraft cable core, snaphooks and neoprene coated counter weight.
4. Pole shall have reinforced flush pivot access door with continuous piano hinge and cylinder lock for winch access.
5. Provide removable winch handle for raising and lowering flag through an access hole in the pole.

2.03 FINISH

A. Finish exposed surfaces of flagpoles.

B. Flagpole shaft: Satin brushed aluminum, then heavily waxed.

C. Finial ball: Gold anodized aluminum, then heavily waxed.

D. Base and cleats: Finish to match flagpole.

E. Stainless Steel (base): As recommended by flagpole manufacturer.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Set flagpoles in concrete base. Provide galvanized, corrugated steel sleeve or tube of length recommended by manufacture and welded to steel base plates for installation in concrete.

B. Wrap top of sleeve with two layers of asphalt felt for distance of two feet down.

C. Fill space between pole and metal sleeve to within two inches of top with fine dry sand and fill balance of space with waterproof compound as shown.

3.02 LIGHTNING ROD

A. Weld lightning ground rod of 3/4-inch diameter galvanized steel to base plate at bottom of sleeve or tube, and to steel support plate at grade.

END OF SECTION

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SECTION 10 44 16

FIRE EXTINGUISHERS

PART 1 - GENERAL

1.01 SUMMARY

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 1 – GENERAL REQUIREMENTS, which are hereby made a part of this Section of the Specifications.

B. Section Includes:
   1. Fire extinguishers.
   2. Extinguisher cabinets.
   3. Accessories.

1.02 REFERENCES

A. ASTM E814 – Standard Test Method for Fire Tests of Penetration Firestop Systems.

B. Massachusetts State Building Code: 780 CMR 9th edition.

C. Intertek Testing Services/Warnock-Hersey International (ITS/WHI).

D. NFPA 10 – Standard for Portable Fire Extinguishers: For criteria covering installations for Class A, B, C, D, and K hazards as well as the selection, inspection, maintenance, recharging, and testing of portable fire extinguishing equipment.

E. Underwriters Laboratories (UL).

1.03 SUBMITTALS

A. Submit in accordance with Section 01 33 00, SUBMITTALS.

B. Product Data:
   1. Cabinets: Materials description for fire extinguisher cabinets include roughing-in dimensions, details showing mounting methods, relationships to surrounding construction, door hardware, cabinet type and materials, trim style and door construction, door styles and materials.
   2. Extinguishers: Materials description for fire extinguishers; include ratings and classifications.
   3. Installation instructions for each product specified.

C. Shop Drawings:
   1. Small-scale plans showing locations of fire extinguisher cabinets and individual fire extinguishers.
   2. Schedules showing each type of cabinet and extinguishers to ensure proper fit and function.
   3. Indicate installation procedures and accessories required for a complete installation.

D. Samples:
   1. Extinguisher Cabinet Door and Trim Finishes: For each type of exposed finish required, prepared on sample sizes 6” square.

1.04 QUALITY ASSURANCE

A. Provide extinguishers, cabinets and accessories produced by a single manufacturer.

B. Fire-Rated, Fire Protection Cabinets: Listed and labeled to comply with requirements in ASTM E814 for fire-resistance rating of walls where they are installed.

1.05 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, and handle fire protection specialties and related materials using means and methods that will prevent damage, deterioration, or loss.

B. Deliver components in manufacturer’s original packaging, properly labeled for identification.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Acceptable Manufacturer: J.L. Industries, Inc., 9702 Newton Ave S, Bloomington MN 55431, or approved equal.

2.02 FIRE EXTINGUISHER

A. Multi-Purpose Chemical Type: Extinguisher unit containing a fluidized and siliconized mono ammonium phosphate power; nonconductive and nontoxic.
   1. Construction: Heavy duty steel cylinder with metal valve and siphon tube, O-ring seal, replaceable valve stem seal, visual pressure gage, pull pin and upright squeeze grip.
   2. Finish: Factory powder-coated; Red.

3. Effectiveness (Rating): Class A, B, and C fires.
4. Basis of Design Product: J.L. Industries Cosmic 10E, 4A-80BC, or approved equal.

2.03 FIRE EXTINGUISHER CABINET

A. Recessed Cabinet with Aluminum Trim and Door:
   1. Basis of Design Product: J.L. Industries Academy Series #1022, or approved equal.
   2. Cabinet Style: Semi-recessed.
   3. Components:
      a. Tub: Cold-rolled steel.
         1) Finish: Factory-applied powder coat paint finish, color to be white.
      b. Door and Trim Construction: Aluminum; flush door with 5/8-inch door stop attached by continuous hinge and equipped with zinc-plated handle with roller catch.
         1) Finish: Factory anodized finish, clear.
      c. Door Style: Style F; Full glazing with pull handle.
      d. Door Glazing: Type 17; Clear tempered glass.
      e. Trim Style and Depth: Semi-recessed cabinet.
         1) Rolled Edge: 4 inch.
   4. Fire Rating: Nonfire-rated.

B. Surface Mounted Cabinet with Acrylic Bubble Door:
   1. Basis of Design Product: J.L. Industries Clear Vu Series #1533, or approved equal.
   2. Cabinet Style: Surface-mounted.
   3. Components:
      a. Tub: Anodized aluminum, clear.
      b. Stainless Steel Door and Trim Construction: Flush doors with 5/8-inch door stop attached by continuous hinge and equipped with zinc-plated handle with roller catch.
         1) Finish: Factory-applied #4 directional satin finish.
      c. Door Style: Style F; Full glazing with pull handle.
      d. Bubble: Acrylic bubble with 2-1/2 inch projection. Standard color, 25-clear.
      e. Trim Style and Depth: Standard profile, square edge.
   4. Fire Rating: Nonfire-rated.

C. Wall Signs:
   1. Basis of Design Product: J.L. Industries #25, or approved equal.
   2. Plastic sign 4” x 12”, flush vertical “FIRE EXTINGUISHER”.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine walls and partitions for suitable framing depth and blocking where recessed and semi-recessed cabinets will be installed, and blocking where surface mounted cabinets will be installed.
   1. Notify the Architect in writing of conditions detrimental to proper and timely completion of the installation.
   2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install cabinets in locations and at mounting heights indicated, or if not indicated, at heights to comply with applicable regulations of governing authorities.
   1. Prepare recesses in walls for fire extinguisher cabinets as required by type and size of cabinet and style of trim to comply with manufacturer's instructions.
   2. Securely fasten mounting brackets and fire extinguisher cabinets to structure, square and plumb, to comply with manufacturer's instructions.
   3. Maintain fire ratings where cabinets are recessed into fire-rated wall systems.

B. Wall Signs:
   1. Locations: Install wall signs at each fire extinguisher location.
   2. Apply on walls and structure after field painting is completed and has been accepted.

3.03 FIELD QUALITY CONTROL

A. Ensure that each extinguisher is fully charged, and that inspection of each extinguisher has been performed, as evidenced by the National Association of Fire Equipment Distributors certification tag, just prior to turnover.

3.04 ADJUSTING AND CLEANING

A. Remove temporary protective coverings and strippable films, if any, as fire extnguisher cabinets are installed unless otherwise indicated in manufacturer's written installation instructions.

B. Adjust fire extinguisher cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.

C. On completion of fire extinguisher cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.

D. Touch up marred finishes, or replace fire extinguisher cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by fire extinguisher cabinet and mounting bracket manufacturers.

E. Replace fire extinguisher cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

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SECTION 10 50 00

METAL LOCKERS

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 1 - GENERAL REQUIREMENTS, which are hereby made a part of this Section of the Specifications.

B. Heavy Gauge Welded Duty Lockers.

C. Locker benches.

1.02 REFERENCES

A. ADAAG – Americans with Disabilities Act, Accessibility Guidelines.

1.03 SUBMITTALS

A. Submit under provisions of Section 01 33 00, SUBMITTALS.

B. Shop Drawings: Show the following:
1. Dimensioned drawings including plans, elevations, and sections to show locker locations and interfaces with adjacent substrates.
2. Details of assembly, erection, anchorage and clearance requirements.

C. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and finishes.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Protect locker finish and adjacent surfaces from damage.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Acceptable Manufacturer: Penco Products, Inc. "Patriot" Duty lockers, or approved equal.

B. Lockers shall be GREENGUARD Gold Certified by UL Environment through the GREENGUARD Certification Program.

2.02 MATERIALS

A. Steel: Prime grade mild cold-rolled sheet steel free from surface imperfection, capable of taking a high-grade enamel finish and in compliance with ASTM A1008.

B. Steel: Sheet steel components shall be fabricated using zinc-coated steel free from surface imperfection, capable of taking a high-grade enamel finish and in compliance with ASTM A879.

C. Bolts and Nuts: Zinc plated truss fin head bolts and hex nuts.

D. Provide only metal lockers fabricated in the United States by a single domestic manufacturer.

2.03 HEAVY GAUGE PERSONAL DUTY LOCKERS

A. Heavy Duty Lockers: All locker body components made of cold rolled steel specially formed for added strength and rigidity and to ensure tight joints at fastening points.

B. Locker Body: All-Welded Duty Lockers.
   1. Sides, Bottoms, Tops, and Shelves:
      a. 16 gauge steel.
      b. Solid sides punched for shelf locations on nominal 12 inch centers.
   2. Backs: Solid 18 gauge steel.
   3. Doors:
      a. 14 gauge steel.
      b. Standard Ventilation: 6 inch (152.4 mm) wide by 3/4 inch (19 mm) high horizontal louvers arranged in two groups of six.
      c. Optional Ventilation: 3/4 inch (19 mm) wide by 1-1/2 inch (38 mm) high diamond-shaped perforations or 3/4 inch (19 mm) wide by 1/4 inch (6.4 mm) high security mini louvers.
      d. Solid doors.
   4. Sides: Vertical frames and sides.
      a. Ventilation: Solid sides
      b. Optional Ventilation: 3/4 inch (19 mm) wide by 1-1/2 inch (38 mm) high diamond-shaped perforations.
   5. Tops: Notched and formed sheet; one continuous flat top for each locker.

a. Top shall have a pattern of 1x1/8” slots to facilitate airflow.
b. Top shall have a single gang duplex knockout for electrical service provided by other.

7. Shelves: Flanged four sides with additional return flange on front edge to increase strength.
8. Door frames: 16 gauge formed in a channel shape with continuous vertical door strikes.
   a. Vertical frame members shall be integral with locker side panel. Separate frame and side pieces fastened by welding or nut and bolt are not acceptable.
9. Locker Width: 18 inches.

C. Locker Doors: One piece sheet steel.
1. Provide holes for attaching number plates.
2. Ventilation: Provide louvered doors in manufacturer's standard louver pattern.

D. Hinges:
1. Continuous type: 16 gauge piano hinge measuring full height of door. Welded to door and attached to locker frame using steel rivets.

E. Duty Locker Open Base with Integral Seat:
1. Welded open base assembly punched for attachment to upper locker: 14 gauge steel, 18 inches high by 33 inches deep and same width as locker.
2. Hardwood seat: Laminated selected hardwood, 1-1/4 inch (31 mm) full finished thickness, corners rounded and sanded, surfaces finished with two coats of clear lacquer.
   a. Width: 9-1/2 inches (240 mm) wide.
   b. Length: As shown, continuous along adjoining lockers with drawer bases.

2.04 DOOR HANDLES AND LATCHING

A. Single Tier Lockers:
1. Cremone Latching: Handle shall be a heavy duty turn handle that engages the door frame on three sides. The top and bottom frames are engaged with 3/8 inch (9.5 mm) steel rods, and a 1/8 inch (3 mm) thick center latch engages at the side.
   a. Double door configurations shall consist of a left hinged door secured its full length by the right hinged door when latched.
   b. Handle Assembly shall be secured to door using a threaded lock nut to facilitate adjustment and removal for repair if necessary. Welded handle assemblies shall not be accepted.
2. Multi-point latching with recessed handle, single door up to 24 inch wide only:
   a. Recess finger-lift control handle in door.

b. Pocket: 22 gauge brushed stainless steel securely fastened to door with two tabs and a positive tamper-resistant decorative fastener; of depth sufficient to prevent a combination padlock, built-in combination lock, or key lock from protruding beyond door face.
c. Provide lock hole cover plate for use with padlocks.
d. Attach 14 gauge formed steel lifting piece to latching channel with one concealed retaining lug and one rivet, assuring a positive two-point connection.
e. Handle Finger Lift: Molded, sound-deadening, attached with rivet; padlock eye for use with 9/32 inch (7.1 mm) diameter padlock shackle.
f. Latch Clip: Glass-filled nylon engaging the door frame and holding the door shut.
    1) Doors 60 inches (1.524 m) High: Three points.
    2) Doors 72 inches (1.828 m) High: Three points.
g. Locking Device: Positive, automatic type, whereby locker may be locked when open, then closed without unlocking.
h. Firmly secure one rubber silencer in frame at each latch hook.

2.05 INTERIOR EQUIPMENT

A. Heavy Duty All-Welded Duty Lockers With Doors:
    1. Single-Tier, shelf located approximately 12 inches (304.8 mm) below top of locker.
        a. Pattern of 42 ½ inch holes on 1 inch centers centered over garment side of locker to facilitate airflow.
    2. Interior vertical subdivision, 16 gauge
    3. Security Compartment; Equipped with chrome knob and punched to accept built-in lock.
        a. Bottom of compartment punched to accept double prong hook
    4. Openings 24 inches (609.6 mm) deep: Two heavy duty 7/8 inch x 2-1/4 inch x 3 inch single prong wall hooks and one 1 inch diameter coat rod.

2.06 ACCESSORIES

A. Number Plates: Provide each locker with a polished aluminum number plate, 2-1/4 inches (57 mm) wide by 1 inch (25 mm) high, with black numerals not less than 3/8 inch (9.5 mm) high; attach to face of door with two aluminum rivets.

B. Interior Equipment
    1. Optional Acrylic mirror: Self adhesive, 6 inch (152.4 mm) x 8 inch (203.2 mm).
    2. Optional Side Shelves: 16 gauge, flanged on four sides and attached securely to center partition and locker side.

a. Punch to accept double prong hook.

3. Optional cell phone/key tray: 8 inch (203.2 mm) x 2 inch (50.8 mm) x 2 inch (50.8 mm). Attaches to vertical subdivision.
4. Optional sheet steel document sleeve. 16 gauge measuring 12 inches wide (horizontal storage) or 9-1/2 inches wide (vertical storage) and attached using supplied hardware.
5. Optional Garment separator. Formed from16 gauge sheet steel and perforated. Mounted underneath the full width shelf.
6. Optional Parachute/body armor rack. Formed from ¾ inch diameter, heavy wall steel tube. Reinforced by 14 gauge gussets and supports and mounted securely to locker back. Replaces standard rear mounted coat hooks. 180 pound capacity.

H. Continuous sloped hoods: 16 gauge steel, slope rise equal to 1/3 of the locker depth (18.5 degrees), plus a 1 inch (25 mm) vertical rise at front.
1. Supplied in 72 inch (1829 mm) lengths only.
2. Slip joints without visible fasteners at splice locations.
3. Provide necessary end closures.
4. Finish to match lockers.

I. Finished End Panels: Minimum 16 gauge steel formed to match locker depth and height, 1 inch (25 mm) edge dimension; finish to match lockers. Install with concealed fasteners.

J. Front Fillers: 20 gauge steel formed in an angle shape, with 20 gauge slip joint angles formed in an angle shape with double bend on one leg forming a pocket to provide adjustable mating with angle filler.
1. Attachment by means of concealed fasteners.
2. Finish to match lockers.

2.07 FABRICATION

A. Fabricate lockers square, rigid, without warp, with metal faces flat and free of distortion.

B. Finish: Enamel powder coat paint finish electrostatically applied and properly cured to manufacturer’s specifications for optimum performance. Finishes containing volatile organic compounds and subject to out-gassing are not acceptable. Locker exterior and interior shall be painted the same color.
1. Powder Coat - Dry Thickness: 1 to 1.2 mils (0.025 to 0.03 mm).
2. Powder Coat Plus - Dry Thickness: 2 to 2.2 mils (0.05 to 0.055 mm).
3. Color: 806 “Marine Blue”.
4. Special Finish
a. Custom color
b. Anti-Graffiti
c. Anti-Microbial
d. TGIC
e. Ultra-Weatherable

PART 3 – EXECUTION

3.01 EXAMINATION

A. Do not begin installation until substrates and bases have been properly prepared.

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

3.02 INSTALLATION

A. Install metal lockers and accessories at locations shown in accordance with manufacturer's instructions.

B. Install lockers plumb, level, and square.

C. Anchor lockers to floor and/or wall at 36 inches (0.914 m) or less, as recommended by the manufacturer.

D. Bolt adjoining locker units together to provide rigid installation.

E. Install sloping tops and metal fillers using concealed fasteners. Provide flush hairline joints against adjacent surfaces.

F. Install benches by fastening bench tops to pedestals and securely anchoring to the floor using appropriate anchors for the floor material.

3.03 ADJUSTING AND CLEANING

A. Adjust doors and latches to operate without binding. Verify that latches are operating satisfactorily.

B. Adjust built-in locks to prevent binding of dial or key and ensure smooth operation prior to substantial completion.

C. Touch-up with factory-supplied paint and repair or replace damaged products before substantial completion.

3.04 PROTECTION

A. Protect installed products until completion of project.

END OF SECTION

SECTION 10 80 00

BUILDING ACCESSORIES

PART 1 GENERAL

1.01 DESCRIPTION

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 1 – GENERAL REQUIREMENTS, which are hereby made a part of this Section of the Specifications.

B. This section specifies miscellaneous items used in the buildings.

C. Items Specified:
1. Building Signage.
2. Wash bay curtain.

1.02 SUBMITTALS

A. Submit in accordance with Section 01 33 00, SUBMITTALS.

B. Manufacturer's Literature and Data:
1. All items specified.
2. Show type of material, gages or metal thickness in inches, finishes, and when required, capacity of accessories.
3. Warranty and operation manuals.

1.03 QUALITY ASSURANCE

A. Each product shall meet, as a minimum, the requirements specified, and shall be a standard commercial product of a manufacturer regularly presently manufacturing items of type specified.

B. Each building accessory shall be assembled to the greatest extent possible before delivery to the site.

C. Include additional features, which are not specifically prohibited by this specification, but which are a part of the manufacturer's standard commercial product.

D. Building accessories shall be warranted for a period of one year.

1.04 PACKAGING AND DELIVERY

A. Pack building accessories individually to protect finish.

B. Deliver building accessories to the project only when installation work in areas are ready to receive them.

C. Deliver inserts and rough-in frames to site at appropriate time for building-in.

PART 2 PRODUCTS

2.01 PRODUCTS

A. Building Signage:
   1. Provide 1/8” thick Helvetica font building letters in aluminum. Alloy #5053 with superior hardness rating of H32, color to be brushed aluminum, clear.
   2. Letters shall be surface mounted with concealed mechanical fasteners.
   3. Height and style as shown on the drawings.

B. Wash Bay Curtain: Clear double polished 20mil PVC. NFPA 701 fire retardant. Finished edges. Double or triple hems used where needed. Supported from roof structure with chain suspended track. Manufacturer: Akon Curtain and Divider, or approved equal.

PART 3 EXECUTION

3.1 PREPARATION

A. Before starting work notify Prime Designer in writing of any conflicts detrimental to installation or operation of units.

3.2 INSTALLATION

A. Install building accessories in accordance with the manufacturer's printed instructions and at locations shown on the drawings. Contractor shall provide all accessories for each item to ensure a complete and fully operational installation of the building accessory.

B. Install building accessories plumb and level.

C. Install building accessories in a manner that will permit the item to function as designed and allow for servicing as required without hampering or hindering the performance of other devices.

D. All building accessories shall be installed with concealed and tamper resistant fasteners and mountings.

END OF SECTION

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SECTION 11 40 00
KITCHEN APPLIANCES

PART 1 - GENERAL

1.01 DESCRIPTION

A. All of the Contract Documents, including General and Supplementary conditions and Division 0 – Bidding Documents, Contract Forms and Conditions of the Contract and Division 1 – General Requirements, apply to the work in this Section.

B. This section specifies appliances used in kitchen.

C. Items Specified:
1. Refrigerator
2. Cooktop
3. Wall Oven
4. Hood

1.02 SUBMITTALS

A. Submit in accordance with Section 01 33 00, SUBMITTALS.

B. Manufacturer's Literature and Data:
1. All appliances specified.
2. Show type of material, gages or metal thickness in inches, finishes, and when required, capacity of accessories.
3. Warranty and operation manuals.

1.03 QUALITY ASSURANCE

A. Each product shall meet, as a minimum, the requirements specified, and shall be a standard commercial product of a manufacturer regularly presently manufacturing items of type specified.

B. Each appliance shall be assembled to the greatest extent possible before delivery to the site.

C. Include additional features, which are not specifically prohibited by this specification, but which are a part of the manufacturer's standard commercial product.

D. Appliances shall be warranted for a period of one year.

1.04 PACKAGING AND DELIVERY

A. Pack appliances individually to protect finish.

B. Deliver appliance to the project only when installation work in rooms is ready to receive them.

C. Deliver inserts and rough-in frames to site at appropriate time for building-in.

PART 2 - PRODUCTS

2.01 PRODUCTS

A. General: Appliances shall comply with the provisions of the Massachusetts Architectural Access Barrier Regulations (MAAB) and ADA regulations.

B. Refrigerator:
1. Electric bottom-mounted no-frost (nominal) 20.3 cubic foot capacity refrigerator freezer.
2. Freezer portion to be separate from refrigerator.
3. Two adjustable F/W, two fixed door and two separate vegetable crispers.
4. Overall width 34 inches.
5. Two ice cube trays.
6. Color to be manufacturer's standard "white".
7. Manufacturer: Model GBSC0HBXWW by General Electric or approved equal.

C. Cooktop:
1. Electric two burner coil element cooktop with spill control top.
2. Two 6 inch coil elements with chrome drip bowls.
3. Surface indicator light and front control knobs.
4. Porcelainized steel top.
5. Color to be manufacturer's standard "white".
6. Manufacturer: Model JP202DWW by General Electric or approved equal.

D. Wall Oven:
1. Electric self-cleaning oven with automatic door lock.
2. Installs in 27 inch wall cabinet.
3. Electronic touchpad controls with clock and minute timer.
4. Frameless glass oven door with designer style handle.
5. Broiler pan with grid.
6. Audible preheat signal.
7. Two oven shelves and auto oven shut-off to prevent unwanted oven operation.
8. Color to be manufacturer's standard "white on white".
9. Manufacturer: Model JKP30DPWW by General Electric or approved equal.

E. Hood:
1. 30" two-speed fan control 180-CFM (max.).

2. Two-halogen cooktop lights.
3. Disposable 1-pc grease filters.
4. Non-vented option.
5. Color to be manufacturer's standard "white".
6. Manufacturer: Model JV338HWW with damper by General Electric or approved equal.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before starting work notify Architect in writing of any conflicts detrimental to installation or operation of units.

3.2 INSTALLATION

A. Install appliances in accordance with the manufacturer's printed instructions.

B. Install appliances plumb and level.

C. Install appliances in a manner that will permit the appliances to function as designed and allow for servicing as required without hampering or hindering the performance of other devices.

D. Wall Oven: Install wall oven at a height such that the bottom of the door is 30 inches above the finished floor.

E. Install appliances to prevent striking by other moving, items or interference with accessibility.

END OF SECTION

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SECTION 11 47 00

GARAGE EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 1 – GENERAL REQUIREMENTS, which are hereby made a part of this Section of the Specifications.

B. Items Specified:
   1. 4-post vehicle lift.

1.02 RELATED SECTIONS

A. Section 03 30 00, CAST IN PLACE CONCRETE.

1.03 SYSTEM DESCRIPTION

A. 4-Post Vehicle Lift:
   1. The maximum rated capacity of lift shall be 30,000 pounds. Installation of this equipment shall require no in-ground posts, pits or special foundations. Above ground parallelogram, in-ground or scissor lifts are not acceptable.
   2. Equipment shall be new and furnished with all specified materials for installation when delivered. Used or reconditioned equipment will not be acceptable.
   3. Equipment shall comply with all applicable Federal, State and local regulations and meet OSHA, UL, NEC, and ANSI safety standards.
   4. Equipment shall be ALI certified and tested to the ANSI/ALI ALCTV 2011 automotive lift standard.
   5. Manufacturer shall be a company regularly engaged in the design and manufacturing of 4 post runway lifts up to 30,000 lbs. for a minimum of five years.
   6. All material thickness and structural dimensions are minimums. Dimensional tolerances, unless otherwise noted, are as follows: ±0.25 inch for dimensions less than 10 inches; ±1.0 inch for dimensions 10 inches to 5 feet inclusive; ±3.0 inch for dimensions greater than 5 feet.

1.04 SUBMITTALS

A. Submit in accordance with Section 01 33 00, SUBMITTALS.

B. Manufacturer’s Literature and Data:

1. All equipment specified.
2. Preparation instructions and recommendations.
3. Storage and handling requirements and recommendations.
4. Installation manuals.
5. Operation manuals.
6. Maintenance manuals.
7. Safety manuals.

C. Shop Drawings: Details of construction, relationship with adjacent construction, templates for installation.

1.05 PROJECT/SITE CONDITIONS

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

PART 2 - PRODUCTS

2.01 PRODUCTS

A. Four Post Vehicle Lift:
1. Heavy Duty, Four Post Hydraulic Ramp Lift: As manufactured by Forward Lift CR30, Mohawk Lifts TR-33, or approved equal.
2. Capacity: Maximum 30,000 pounds.
3. Overall Length: 32 feet.
4. Overall Width: 12 feet.
5. Width Inside Columns: Minimum 132 inches.
6. Runway Height: 8-3/8 inches.
7. Runway Width: 24 inches.
8. Width Between Runways: 41 to 48 inches.
9. Rise Time: 105 seconds.
10. Lifting Height: 68 inches.
11. Electric Motor: 208-230/440-460 volt, 3 phase, 60 Hz, 10 HP minimum. Coordinate exact electrical requirements with Electrical Contractor.
12. Runways: Anti-skid diamond plated ramps, bolted down to floor.
13. Heavy duty, high tensile strength leaf chain and sealed roller bearings.
14. Velocity fused redundant hydraulic safety system.
15. Single point actuated lock release.
16. Ten level laddered lock positions.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Prior to starting work, notify Architect in writing of any conflicts detrimental to installation or operation of equipment.

3.02 INSTALLATION

A. Install in accordance with manufacturer's written instructions.

3.03 PROTECTION

A. Protect installed equipment until completion of Project.

END OF SECTION

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SECTION 12 93 00
SITE FURNISHINGS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Procurement and Contracting Requirements and Division 01 General Requirements apply to this Section.

1.02 SUMMARY

A. This Section includes the following:
   1. Steel bollards.
   2. Parking and traffic signs

B. Related Sections include the following:
   1. Division 03 Section "Cast-in-Place Concrete" for installation of cast-in-place concrete footings and slabs.

1.03 SUBMITTALS

A. Product Data: Submit manufacturer's published product data including product specifications, installation instructions, test data and other pertinent technical data for the following site improvements prior to ordering items.
   1. Parking and traffic signs.

B. Shop Drawings: Indicate materials, dimensions, sizes, weights, and finishes of components.
   1. Steel bollards.

1.04 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of site furnishing through one source from a single manufacturer.

PART 2 - PRODUCTS

2.01 STEEL BOLLARDS

A. Steel bollards shall be Schedule 80 hot-dipped galvanized steel pipe. Provide concrete filled pipe as indicated on the drawings.
   1. Steel: Free of surface blemishes and complying with the following:
      a. Standard-weight steel pipe complying with ASTM A 53, or electric-resistance-welded pipe complying with ASTM A 135.
      b. Exposed Surfaces: Polished, sanded, or otherwise finished; all surfaces smooth, free of burrs, barbs, splinters, and sharpness; all edges and ends rolled, rounded, or capped.

2. Galvanizing: Provide the following protective zinc coating applied to components after fabrication.
   a. Zinc-Coated Tubing: External, zinc with organic overcoat, consisting of a minimum of 0.9 oz./sq. ft. of zinc after welding, a chromate conversion coating, and a clear, polymer film. Internal, same as external or consisting of 81 percent zinc pigmented coating, not less than 0.3 mil thick.
   b. Hot-Dip Galvanizing: According to ASTM A 123/A 123M, ASTM A 153/A 153M, or ASTM A 924/A 924M.

B. Metal Finishes:
   1. Shop Painting:
      a. Prime and paint with two finish coats;
         1) Color: Black.
      b. Galvanized metal assemblies shall be given a shop coat of epoxy primer.
      c. Immediately before shop painting, remove all rust, loose mill scale, dirt, weld flux, weld spatter, and other foreign material with wire brushes and/or steel scrapers. Commercial blast clean in accordance with SSPC SP 6. Remove all grease and oil by use of solvent recommended by paint manufacturer.
      d. Apply paint by spray process in strict accordance with manufacturer's printed instructions to uniform thickness recommended by manufacturer. Apply thoroughly and evenly and work well into corners and joints taking care to avoid sags and runs.
      e. Do not paint surfaces to be embedded in concrete, or to be welded in the field. After field welds are complete, grind smooth and flush, thoroughly clean and then apply specified primer over all unprimed surfaces in the field by brush or roller.
      f. After erection, sand smooth and retouch all portions of the shop coats chipped or damaged during erection as specified below.

C. Provide one 3" wide yellow reflective band per bollard of 3M Diamond Grade DG Reflective Sheeting Series 4000 or approved equal.

2.02 PARKING AND TRAFFIC SIGNS

A. Traffic signs shall be in accordance to "Manual on Uniform Traffic Control Devices," U.S. Department of Transportation, latest edition. Signs shall be as follows:
   1. Parking signs with universal symbol of accessibility.

B. Materials for signs and hardware shall be as specified in the Massachusetts Department of Public Works Standard Specifications for Highways and Bridges Section 828, Traffic Signs. Sign facing shall be Type A, .090 inch galvanized or aluminum sign panel, with self-adhesive engineer-grade reflective vinyl sheeting to cover entire face (edges to be dressed). The images shall conform to the federal Manual on Uniform Traffic Control Devices and shall be surface installed self-adhesive engineer grade non-reflective black vinyl. Posts shall be schedule 40, 2”- square, galvanized steel post in accordance with ASTM A53 Type F.

C. All posts and hardware shall be hot dipped galvanized in accordance with ASTM A153.

D. Cast-in-place concrete for footings shall be 3/4"/20mm, 4000 psi/30 MPa conforming to Section M4 of the Standard Specifications, and furnished and installed under this Section.

2.03 FINISHING FOR SIGN POSTS AND HARDWARE

A. Galvanizing: Hot-dip galvanize all ferrous metal under this Section for exterior use, including all bolts, nuts, washers, and other related ferrous metal items.
   1. Hot-dip galvanizing process shall comply with ASTM A 123, A 153, A 385, and A 386, as applicable. After galvanizing, processed items shall be straightened to remove all warpage and distortion caused by the process.
   2. Furnish a certified statement that galvanizing complies fully with this Specification.

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL

A. Comply with manufacturer's written installation instructions unless more stringent requirements are indicated.

B. Install site furnishings level, plumb, true, and securely anchored at locations indicated on Drawings and per Architects final approval.

3.02 STEEL BOLLARDS

A. Locate and install steel bollards as indicated within the drawings, approved shop drawings and as directed by the Architect.

B. Set bollards in concrete footing plumb and true as indicated within the drawings. Keep bollards wrapped in craft paper to eliminate staining until completion of work.

3.03 CLEANING

A. After completing site furnishing installation, inspect components. Remove spots, dirt, and debris. Repair damaged finishes to match original finish or replace component.

END OF SECTION 12 93 00

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Section 13 31 33

PREFABRICATED TENSION MEMBRANE COVERED STRUCTURE

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 1 – GENERAL REQUIREMENTS, which are hereby made a part of this Section of the Specifications.

1.02 GENERAL SCOPE

A. This section specifies the design, manufacture, shipping, handling and installation and erection of a relocatable prefabricated tension membrane covered structures including required structural framing and foundations to support and attach the prefabricated tension membrane covered structures including all accessories, fasteners, trims and structural design as required to facilitate the above noted.

B. It is the intent of this specification that the bidder shall include all labor, materials, equipment services and transportation to locate the building on the site designated with all other work.

C. Building shall be complete and operating and shall include all exterior and interior materials and systems as shown or indicated in the contract documents.

D. All workmen shall be skilled and qualified for the work that they perform. All materials used, unless otherwise specified, shall be new and of the types and grades specified. The contractor shall certify that no asbestos containing building materials that exceed Federal mandated safe asbestos levels have been used in the construction of the membrane-covered structure.

E. Work shall be performed as necessary and required for the construction of the project as indicated. Such work includes the supply and installation of a membrane-covered structure complete with exterior and interior finishes. The building shall be as dimensioned with all features and quantities as indicated in the contract documents.

1.03 SUBMITTALS

A. Submit in accordance with Section 01 33 00, SUBMITTALS.

B. Product Data: Submit manufacturer's current technical literature for the product. Provide product criteria, characteristics, accessories, jointing and seaming methods, and termination conditions.

C. Shop Drawings: Shop drawings are to include at a minimum the following:

1. Plans, elevations, sections, mounting heights, and frame assembly details.
2. Member sizes with wall thickness.
3. Footing layout and foundation design.
4. Fabric attachment hardware and details.
5. Direction, details and locations of fabric seams.
6. Details of fabric dimensions including length of spans, sag curvature and actual shaded area.

D. Qualification Data: Submit qualifications for the installer, fabricator and design engineer.

E. Delegated-Design Submittal for Membrane Structures and Associated Foundations: Prepare and submit detailed stamped drawings, data and analysis for all structural to facilitate the installatin and design of the required membrane structures and associated foundations, stamped and sealed by a qualified licensed professional engineer certified by the State of Massachusetts to verify compliance to local building code and Mass CMR 780 9th edition including amendments. All work to be performed under the conditions of this specification shall comply with the rules and regulations of all agencies having jurisdiction for this classification of construction and design and shall conform to the applicable live loads due to wind, rain and snow. Information provided shall include but not be limited to the below:

1. Plans, elevations, sections, mounting heights, and frame assembly details
2. Frame member sizes and required wall thicknesses.
3. Welding requirements.
4. Details of bolted and pin connections for frame assembly.
5. Required sizes of bolts, pins, plates and tubing.
6. Verify the fabric meets minimum engineering requirements.
7. Details fabric attachment methods and identify thickness of all membrane plates,clamps and other attachment components.
8. Cable sizes and pretension requirements.
9. Anchor bolt plans before foundation work begins. Include location, diameter and projection of anchor bolts required to attach the tensioned fabric structures to the foundation. Indicated colum reactions at each location.
10. Foundation design plans and load and reaction calculations, connections, anchoring and ballasting as required.

F. Product Data: Provide product criteria, characteristics, accessories, jointing and seaming methods, and termination conditions.

G. Samples:

Provides samples of final finish of structure supporting tensioned fabric, tensioned fabrics, and hardware.

1. Tensioned Fabric: 8.5 inch x 11 inch samples of tensioned fabric for appearance, texture, finish and light transmittance.
2. Structure Finish: Manufacturer's standard sample size on metal for color, texture and gloss.
3. Accessories: One of each exposed accessory in selected color and finish.

H. Manufacturer's Installation Instructions:
1. Provide instruction for installation on which the manufacturer warranties are based. Indicate special preparation of substrate, attachment methods, and perimeter conditions requiring special attention.

I. Warranty:
1. Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

J. Maintenance Data:
1. Provide maintenance requirements for Owner to maintain tensioned fabric structure and manufacturer's warranty of materials including methods for maintaining tensioned fabric structure fabrics and finishes. Include precautions about cleaning materials and methods that could be detrimental to fabrics, finishes, and performance.

1.04 STORAGE AND HANDLING

A. Piece Marking and Identification:
1. All individual parts or bundles and packages of identical parts are to be clearly marked or for identification or otherwise identified by clear installation procedures. Bolts and fasteners shall be packaged according to type, size and length. Loose nuts and washers shall be packaged according to size and type. The shipping documents shall list showing the description, quantity and piece mark of the various parts, components and elements.

B. Material Delivery:
1. The building system materials shall be delivered to the project site during normal working hours on weekdays. Installation contractor will provide adequate workmen and equipment to promptly unload, inspect and accept material delivery.

C. Handling:
1. The installation contractor shall be responsible for unloading, field storage, protection and transfer to the work area of all materials and equipment required to perform work. At no time shall materials be dropped, thrown or dragged over the transport equipment or the ground. Damage to any piece under its own superimposed weight shall be cause for repair or replacement. Material shall be protected from standing water.

D. Short, Damaged or Excess Materials:
1. Installation contractor shall inspect, count and verify quantities based on the shipping documents.

1.05 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification. The publications are referenced in the text by basic designation only.

B. American Institute of Steel Construction (AISC):

S326-78	Design, Fabrication and Erection of Structural Steel Buildings
S329-85	Structural Joints Using ASTM A325 or A490 Bolts.

C. American Iron and Steel Institute (AISI)

SG 503-76	The Design of Fabrication of Cold-Formed Steel Structures

D. American Society for Testing and Materials (ASTM):

A 36-89	Structural Steel
A 123 A-89	Standard Specification for Zinc (Hot Dip Galvanized) Coatings on Iron and Steel Products
A 307-89	Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
A 325-89	High-Strength Bolts for Structural Steel Joints
A 500 A-90	Standard Specification for Cold Formed Welded And Seamless Carbon Steel Structural Tubing in Rounds and Shapes
A 563 Rev A-89	Carbon and Alloy Steel Nuts
A 687-89	High-Strength Non-Headed Steel Bolts and Studs.

E. American Society of Civil Engineers (ASCE) Minimum Design Loads for Building and Other Structures. Latest edition as required by State Code.

ASCE 7-02	American Society of Civil Engineers
ASCE 7-05	American Society of Civil Engineers
ASCE 7-08	American Society of Civil Engineers

F. American Welding Society (AWS)

D1.1-2004	Structural Welding Code-Steel
D1.3-98	Structural Welding Code-steel sheet steel

1.06 WARRANTY

A. Fabric Manufacturer Warranty: Provide manufacturer's standard 15 year material replacement warranty for water resistance and tearing of fabric.

1.07 QUALITY ASSURANCE

A. Manufacturer Qualifications:

1. Manufacturer shall have a minimum of five (5) years experience in the production of framed fabric membrane covered structures. Manufacturer shall demonstrate past experience with examples of projects of similar type and exposure.

B. Installer / Supplier Qualifications:
   1. Installer / Supplier shall be authorized by the manufacturer and provide written certification that they have five (5) years of experience installing framed membrane covered structures under the same name.

C. Building Supplier Qualifications:
   1. Supplier must provide written references with contact information for a least three salt storage structures currently in operation in Massachusetts which have a footprint in excess of 4000 square feet.

1.08 WEATHER AND TEMPERATURE REQUIREMNTS

A. The structure shall be capable of being assembled, operated, and dismantled in all ambient temperatures between -20°F and 120°F.

B. Work shall not commence or proceed when, in the sole judgement of the Architect or his authorized representatives, conditions are unfaborable or detrimental to the proper installation of systems.

C. The fabric material shall be designed to withstand a maximum temperature of 150°F when stored in packing containers.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. GENERAL
   1. The membrane shall be tensioned over the framework. The structure shall be the shape shown in the contract documents with vertical gable end walls. The interior of the structure below the main trusses shall be clear span free of any structural support members and shall provide unobstructed floor space. No exterior purlins, guy ropes or cables shall be used for anchoring the structure.

   2. The structure shall include accessories to the extent noted in the contract documents required intended use for:
      a. Overhead doorways
      b. Ventilation systems
      c. Other structure accessories

2. Materials Shed Rigid steel frame supporting membrane covered roof and wall structure:

a. The building will be completely open on one long side wall and enclosed with fabric on the other as indicated in the contract documents.
b. End walls will be enclosed with fabric
c. Minimum height of 20’ under the eave at the open side
d. Bins will be constructed inside to separate different materials as indicated on the contract documents.
e. The structure shall occupy an area of approximately 50'x 80' as indicated on the contract drawings.

3. Salt Shed Rigid steel frame supporting membrane covered roof and wall structure:
a. The structure must provide a minimum clearance of 14’ from top of wall within 3’ of inside edge of foundation. Building must provide an envelope at least 30’ tall by 20’ wide in the middle of the building to allow for trucks to dump and load inside the structure.
b. Flat gable ends with (2) 3’ x 3’ passive vents on each end are required.
c. 20’ wide by 20’ tall door opening to be provided on front wall
d. The structure shall occupy an area of approximately 50'x 80' as indicated on the contract drawings.

B. DESIGN REQUIREMENTS

1. STRUCTURAL FRAME
a. Roof and Wall Surfaces: To provide for maximum compatibility with standard door, window, ventilation and other accessory and cladding systems, the structure shall be designed such that roof and gable side wall surfaces form flat planes.
b. Purlin Spacing: To provide for structural stability and to provide for installation of accessory items, the main structural trusses shall be laterally braced by load bearing purlins at intervals required by the truss design.
c. Wind and Frame Bracing: The structure shall be appropriately stabilized with wind bracing cable as well as any required secondary node restraint assemblies so as to efficiently transfer wind, snow and seismic induced stresses to the foundation/anchoring system. Cable diameter for main wind bracing shall be a minimum of 5/16” diameter and larger if so required. The end bays of the structure shall be designed to be X - braced early during installation to allow for permanent stability of the frame during installation.
1. Connecting Joints: Connections between structural elements shall be designed so as to transfer the compressive and tensile forces present in a given joint. A minimum of Grade 5 bolts shall be used at each truss chord joint. Primary axial steel, secondary purlins, and end wall frame connections shall be made with a minimum of Grade 5 hex bolts, carriage bolts and self-drilling screws.
2. Mechanical Equipment Interface: The main structural roof trusses shall allow for installation of electrical and mechanical equipment

based on collateral loads as defined in section 2.2.2. Likewise, the structure shall accept penetrations through the membrane for access doors and mechanical services with minimal modification.

3. Ancillary Systems: The structure shall be designed such that it can be readily retrofitted with insulation systems and other ancillary systems such as lighting, sprinklers, HVAC, provided collateral load factors of 0.25psf minimum are taken into account.
4. Alternative Cladding materials: The structure shall be designed such that alternative covering materials such as metal wall cladding can be added with minimal modification, if required (provided collateral load factors are taken into account).

2. MEMBRANE CLADDING SYSTEM

1. Membrane: The roof membrane shall form a weather tight shell over the structural frame. In order to provide for a good finished appearance and to insure weather tightness, the membrane shall be assembled and tensioned, in a manner to minimize wrinkles in hot and cold temperatures.
2. The gable wall membrane cladding shall be manufactured and connected to form one piece to the adjacent end wall and roof cladding.
3. Roof membrane horizontal stretch shall be maintained with horizontal purlins requiring no ongoing maintenance. Vertical stretch shall be maintained with a winch lock system (locked with cotter pins) requiring minimal ongoing maintenance.
4. Base Tensioning System: The membrane cladding will be provided with a mechanical tensioning system that allows the membrane to be fully tensioned around the structure perimeter. The system will be designed such that the membrane can be tightly and neatly secured over the structural frame and such that the system has remaining range of adjustment.
5. Membrane Seal at Openings and Base: The Dealer supplying the structure will provide all materials and methods necessary to fully tension and seal the membrane material around all door, ventilation and other openings as well as around the structure perimeter below the main tensioning system. This seal shall provide a neat and finished appearance and eliminate any loose membrane cladding that could otherwise be damaged by flapping or abrasion.
6. The membrane shall not be designed to function as a structural member such that, should any damage to or penetrations of the membrane occur, the integrity of the structural framework shall not be affected.
7. The Contractor shall provide drawings and calculations acceptable to the Architect/Engineer of Record, meeting the provisions of the applicable State Building Code. The Contractor shall bear all costs for production of drawings and associated structural calculations. Contractor shall make all revisions and corrections to those documents required for approval and shall resubmit as required to obtain approvals.

C. ENGINEERED DESIGN CRITERIA

1. The structure shall be designed using methodology as per the ASCE 7 standard referenced from the applicable building code. Primary and secondary framing shall comply with current issues of AISC, AISI, NEMA and ASTM specifications, as applicable. Structural members shall be designed using Allowable Stress Design (ASD) or Load Resistance Factored Design (LRFD) for the design loads given below. Appropriate safety factors to yield and ultimate shall be maintained. Wind load factors and coefficients used in design of structural members must be in accordance with the applicable ASCE 7 guidelines.
    a. Material Storage Structure: The structure must be designed as unheated with a thermal factor(Ct) of 1.2 and an importance factor(I) of 1.0
    b. Salt Storage Structure: The structure must be designed as unheated with a thermal factor(Ct) of 1.2 and an importance factor(I) of .8
2. Snow Loads: The structure shall be designed based upon a minimum flat roof snow load of 35 pounds per square foot (Psf) and minimum ground snow load of 40 pounds per square foot (Psf)
3. Wind Loads: The structure shall be capable of withstanding a basic wind speed (3-second gust) from any direction of 118 miles per hour. The design wind pressure shall be based on an exposure category of C and appropriate wind load factors and coefficients in accordance with the applicable referenced ASCE 7 guidelines. In no event shall the wind load used in the design of the main wind force resisting system be less than 10 pounds per square foot multiplied by the area of the building or structure projected on a vertical plane that is normal to the wind direction (or as prescribed by the applicable building code).
4. Rainfall: The structure shall be capable of withstanding the effects of rainfall up to 4 inches per hour for at least 2 hours.
5. Deflection: For safety of specified or future suspended accessories, the maximum allowable deflection of structural members shall be no more than 1/180 of the clear span of that member when subjected to the design loads described herein.
6. Design Loads: The design shall be based as a minimum on the following design loads. Each member shall be designed to withstand stresses resulting from combinations of design loads that produce maximum percentage of actual to allowable stress in that member as per referenced ASCE 7 standard from applicable building code.

    a. D= Dead Load + Collateral Load
    b. S= Symmetrical Snow or Live Load (Balanced or Unbalanced)
    c. Ws = Wind with internal suction
    d. Wp = Wind with internal pressure

2.02 MATERIALS

A. All materials used in the structure shall be new, without defects and free of repairs. The quality of the materials used shall be such that the structure is in conformance with the performance requirements as specified herein.

B. CLADDING MEMBRANE:

1. The structure shall be clad with an HDPE fabric manufactured by an approved and reputable supplier with demonstrated long-term performance. The membrane fabric shall be waterproof and free from defects. All roofs, walls, end walls and connecting sections shall be weather tight. The material will be selected from the manufacturer's standard colors for the sidewalls and roof panels. The material scrim and coating must be UV stabilized and must carry a minimum 15-year manufacturer's warranty and have a minimum life expectancy of 10 to 15 years.

   The minimum Polyethelene fabric specification is as follows:

a. Total Fabric Weight	12.1 oz/yd² +/- 5%
b. Coating Thickness	3.9mils average, each side
c. Finished Thickness	24 mils (ASTM D-5199)
d. Grab Tensile Strength	Warp 414lbf/Weft 446lbf (ASTM D-751)
e. Strip Tensile Strength	Warp 468lbf/2in/Weft 504lbf/2in (ASTM D882)
f. Tongue Tear Strength	Warp 94lbf/Weft 108lbf (ASTM D-2261)
g. Flammability	Class A (ASTME84-94)
h. Color	"Gray", non-glare finish.

2. Acceptable membrane suppliers include: Intertape Polymer Group - Sarasota, Florida; Fabrene Inc. - Northbay, Ontario, Canada; and Hagihara Industries, Japan.

3. The membrane manufacturer must demonstrate a minimum of five years successful field experience with provision of polyolefin membrane cladding in use on similar or larger size structures of the type indicated in the contract documents.

C. METAL STRUCTURE:

1. The main structure shall consist of a welded truss arches with parallel tube chords separated apart by webbing. Truss sections are manufactured and post dip galvanized to insure proper protection on the inside as well as the external surfaces of the truss sections. All sections must be hot dipped galvanized post fabrication to a minimum of CSA G-164 / ASTM A123-09. Truss will be manufactured of a cold-formed and induction welded modified grade carbon steel, providing a finished tubular product with exceptional mechanical and corrosion resistant properties.
2. Tolerances: All dimensional tubing tolerances are in accordance with ASTM A500, Section 10.
3. Tubing shall be manufactured using steel conforming to ASTM A568, ASTM A1011 and G40.21 350W. Finished steel tubing used in the

structure must have the following minimum structural and mechanical properties based on standard ASTM A500:

a. ASTM A500 Grade C: Tension Ultimate: 55 KSI and Yield: 46 KSI
b. ASTM A500 Grade B: Tension Ultimate: 55 KSI and Yield: 42 KSI
c. G40.21 350W: Tension Ultimate: 55 KSI and Yield: 50 KSI

4. All steel flat bar, cross rods and other steel components shall be fabricated from hot dipped galvanized material, meet the stated standards and have the following minimum structural and mechanical properties (ASTM 44W):
   a. Tensile: 50 KSI and Yield: 44 KSI
5. Corrosion Protection: All Metal sections shall be hot dipped galvanized to a minimum of CSA G-164 / ASTM A123-09. This allows for maximum protection on all welded surfaces including the interior sections. Flow coat process will not be acceptable (Commonly referred to as inline galvanizing).

D. HARDWARE:

1. Bolts: Bolts subject to extreme stress and wear shall be structural bolts of Grade 5 and plated / galvanized that has been upgraded with a corrosion resistant topcoat finish. All bolts shall be installed and securely torqued so as to prevent change in tightness. Those subject to removal or adjustment shall not be swaged, peened, staked or otherwise installed.
2. Membrane Tensioning Hardware: The fabric membrane shall be tensioned with load rated hardware which is plated/hot dip galvanized so as to prevent corrosion. Hardware shall allow full and free rotation at the foundation connection to avoid fatigue failure of threaded assemblies.
3. Membrane Tensioning Webbing: The membrane shall be tensioned with load-tested tie-downs.
4. Cable Assemblies: Main and wind bracing cable assemblies shall be manufactured to the required length and press swaged with metal sleeves. The cables are manufactured using preformed 7-19 stainless steel cables, sized with appropriate safety factors.
   a. 3/16” dia. = 4,200 lbs.
   b. 1/4" dia. = 7,000 lbs.
   c. 5/16” dia. = 9,800 lbs.
   d. 3/8” dia. = 14,400 lbs.
   e. 1/2" dia. = 22,800 lbs
5. Other Fasteners: Non-structural fasteners such as wood screws, Tek screws, etc., shall be of standard commercial quality
6. Exterior Trim: The aluminum alloy used in the extrusion shall meet or exceed 6063-T6.

E. LARGE FORMAT CONCRETE BLOCK FOUNDATION :

1. Foundation walls are to be constructed of large format precast concrete blocks sized as required by the structural engineers design (minimum 30" deep x 60 long x 30" high") which are neat in appearance (no waste blocks).
2. Foundation wall / large format concrete blocks must be buttressed and plated together at each truss landing per the structural engineers design.
3. Foundation wall / large format concrete blocks must be plated together between buttresses per structural engineers design.
4. Butyl based sealant must be applied between blocks to seal the foundation.
5. Concrete blocks must achieve a minimum compressive strength of 3000psi in 28 days or less
6. Blocks must be square, flat on all surfaces and parallel to tolerance not to exceed1/16” per foot on all sides
7. Foundation must be a minimum of 8’-0" tall above slab on grade at the interior of the membrane structure.
8. Foundation walls at the salt storage structure must include 1/2" strapping covered by 1/2” pressure treated plywood to protect the foundation walls. Design of plywood attachment to be such that plywood can be easily removed and replaced.

2.03 ACCESSORIES

A. Fasteners:
1. All accessory materials required by the manufacturer for a warrantable installation of the installed products in a manner that meets the performance and design criteria.

PART 3 EXECUTION

3.01 INSTALLATION

A. General: Install all materials in accordance with manufacturer's instructions based on conditions present.

B. Building prefabrication shall be performed under factory conditions in a plant specifically arranged for this type of work. Contractor shall provide adequate space, equipment, personnel, and technical ability to coordinate the assembly and factory prefabrication of all major components of the work and all necessary operations in the packing, shipping and installation procedures. No fabrication shall be done until the materials have been tested and approved.

C. Welding: Welding shall be employed only when specified in the original design. As per Section 1704.2 of IBC, the truss fabricator must be an Approved Welding Fabricator.

D. Manufacturer: The structure supplier shall be a reputable manufacturer, shall have a

direct experience in the design, manufacture and installation of structures of the type specified herein; shall operate according to a comprehensive quality system and shall provide three references with structures in use for at least five years which are clear span and each must enclose an area in excess of the square footage as stated in this specification.

E. Metal Structure:

1. Clean and strip primed steel items to bare metal where site welding is required.
2. Supply setting templates to the appropriate entities for steel items required to be cast into concrete or embedded in masonry.
3. Install items plumb and level, accurately fitted, free from distortion or defects.
4. Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.
5. Field weld components indicated.
6. Perform field welding in accordance with industry standards.
7. Obtain approval prior to site cutting or making adjustments not scheduled.
8. After erection, prime welds, abrasions, and surfaces not shop primed or galvanized, except surfaces to be in contact with concrete.
9. Cables and fittings to be be installed according to manufacturer's instructions to insure Owner receives a warrantable installation.

END OF SECTION

Section 13 34 19
PRE-ENGINEERED BUILDING

PART 1 - GENERAL

1.01 GENERAL

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 1 – GENERAL REQUIREMENTS, which are hereby made a part of this Section of the Specifications.

B. This specification defines the design requirements and materials standards for the design, supply, fabrication, delivery and erection of building systems. Acceptable manufacturers are American Buildings Company, Varco-Pruden Buildings, Butler or approved equal and as specified below.

C. Work Included: Provide design, labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:
   1. Pre-Engineered, pre-fabricated metal building including all components and assemblies that form a building, such as:
      a. Structural steel main building frames.
      b. Structural steel mezzanine floor framing, including concrete slabs on steel decking.
      c. Secondary framing including purlins, girts and supports for openings and mechanical components.
      d. Bridge crane support including columns and runway beams.
      e. Vertical steel walls and steel roof system with slopes as shown in drawings.
      f. Building anchor bolt sizes, material designation, embedment and length.
   2. Building dimensions shall be as indicated. The minimum inside clear dimensions shall be as shown on the drawings.
   3. **Section 07 41 00, METAL ROOF PANELS is made part of this Section**.
   4. **Section 07 42 00, METAL WALL PANELS is made part of this Section.**

1.02 RELATED WORK:

A. Section 03 30 00, CAST-IN-PLACE CONCRETE.

B. Section 04 20 00, UNIT MASONRY.

C. Section 07 41 00, METAL ROOF PANELS. **Made part of this Section.**

D. Section 07 42 00, METAL WALL PANELS. **Made part of this Section**.

E. Section 09 90 00, PAINTING.

F. Section 21 00 01, FIRE PROTECTION.

G. Section 22 00 01, PLUMBING.

H. Section 23, 00 01, HVAC.

I. Section 26 00 00, ELECTRICAL.

J. Section 41 22 13, BRIDGE CRANE.

1.03 SUBMITTALS

A. Submit in accordance with Section 01 33 00, SUBMITTALS.

B. Building structural design indicating column reactions for all load combinations stipulated on the Drawings and in conformance with 780CMR, 9th edition. These loads will be used to verify the design of the supporting concrete foundation. It is requested that this submittal be prepared and submitted ahead of other submittals.

C. Shop Drawings:
1. The Contractor shall submit for review complete shop drawings (copies and one reproducible set) of the pre-engineered buildings including manufacturer's specifications, catalogs, anchor bolt size, embedment and layout, sizes and locations of all primary and secondary framing members, including bracing, roof and wall panel layouts, trim details, and louvers, doors and hardware schedules.
2. The final shop drawings shall be stamped and signed by a professional engineer registered in the Commonwealth of Massachusetts.

D. Complete design calculation of the superstructure and its anchor bolts, sealed and signed by professional structural engineer registered in Massachusetts. A program of special tests and inspections as required by the Building Official and 780 CMR, 9TH edition.

E. Samples: Provide samples for the following items:
1. Roof and wall panels (12 inch x 12 inch).
2. Each type of sealant and mastic (one tube).
3. Each type of typical fasteners.
4. Each type of insulation with facing (12 inch x 12 inch).

F. Manufacturer's Literature and Data: Submit manufacturer's written data and certificates on the physical characteristics for the following items:
1. General product information on pre-engineered buildings.
2. Roof and wall panels.
3. Each type of mastic and sealant.
4. Each type of insulation with facing.

5. Standard color charts.

G. Certificates and Warranties:
   1. Certificate of Design.
   2. Metal roof and siding warranty certificate.
   3. Envelope watertightness warranty certificate.
   4. Galvanizing warranty certificate.
   5. Manufacturer's erection certification.

1.04 QUALITY ASSURANCE

A. Qualifications:
   1. Manufacturer: Shall have a minimum of five (5) years successful experience in supplying the principal materials and components described in this section and have a minimum of five (5) years successful experience manufacturing/fabricating the specific product line submitted. The manufacturer shall be chiefly engaged in the practice of designing and fabricating steel building systems. The manufacturer shall be certified under the Metal Building Systems (MB) Certification Program, AISC FCD. Structural framing and covering shall be designed by a licensed Professional Engineer registered in the Commonwealth of Massachusetts and experienced in design of this work.
   2. Provide secondary components and materials specified in this section as recommended by the manufacturer.
   3. Erection Contractor: Shall have a minimum of five (5) years successful experience in erecting similar size buildings. Framing shall be erected in accordance with MBMA Low Rise Manual, common industry practices and erection instructions describing the basic sequence of assembly, temporary bracing, shoring, and related information necessary for erection of the metal building including its structural framework and components. The erector shall furnish temporary guys and bracing where needed for squaring, plumbing, and securing the structural framing against loads acting on the exposed framing, such as wind loads and seismic forces, as well as loads due to erection equipment and erection operation. Bracing furnished by the manufacturer for the metal building system shall not be assumed to be adequate during erection. Structural members shall not be field cut or altered without approval of the metal building manufacturer. Welds, abrasions, and surfaces not galvanized shall be primed after erection.
   4. Erector shall investigate and be familiar with the site to prevent causing damage to existing adjacent structures and utilities, above or below grade, during the erection of the structure. Erector shall be fully liable for any damage caused to existing adjacent structures and utilities above or below grade.
   5. A representative designated by the building manufacturer, who is familiar with the design of the building supplied and experienced in the erection of metal buildings similar in size to the one required under this contract, shall be present at the job site during construction, from the start of the structural framing erection until

completion of the installation of the exterior covering, to assure that the building is erected properly.

B. Certificates and Warranties:
   1. A certificate of design (see certificate at end of this section) shall be submitted to the Architect prior to the production of the pre-engineered buildings. The certificate shall state the following:
      a. Codes and specifications that members were designed in conformance with.
      b. Type and strength of materials to be used for all members.
      c. Loading conditions considered in the design for all members.
   2. Manufacturer is to approve and certify in writing that the method and quality of the building erection is in accordance with the manufacturer's recommendations at the completion of the Project.
   3. The building and components shall have a one (1) year warranty from the date of Final Acceptance.
   4. The roof and wall panels and trims (shop painted) shall have a minimum twenty (20) year warranty against fading, chipping, pealing, rupture, structural failure or perforation due to normal atmospheric corrosion.
   5. Watertight envelope system non-prorated warranty for 20 years against leak due to ordinary climatic and atmospheric conditions. The warranty will cover all labor and materials required to repair the leak.
   6. All other components and galvanizing shall have a minimum five (5) year warranty from corrosion under normal use.
   7. Contractor and manufacturer to submit written copy of all warranties at the completion of the project.

C. Coordination Meeting:
   1. A coordination meeting shall be held within 45 days after contract award for mutual understanding of the metal building system contract requirements. This meeting shall take place at the building site and shall include representatives from the Contractor, the roofing/metal building system manufacturer, the roofing/metal building supplier, the erector, the designer, and the Owner’s Represntative. All items required by paragraph SUBMITTALS shall be discussed, including applicable standard manufacturer shop drawings, and the approval process. The Contractor shall coordinate time and arrangements for the meeting

1.05 ABBREVIATIONS

A. The abbreviations listed below shall mean:

AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
ASTM	American Society for Testing and Materials
AWS	American Welding Society
MBMA	Metal Building Manufacturers Association

SSPCS	Structural Steel Painting Council Standards
UL	Underwriters Laboratory

1.06 APPLICABLE PUBLICATIONS, CODES AND STANDARDS

A. The latest editions of the publications listed below form a part of this specification. The publications are referenced in the text by the basic designation only.

B. Pre-Engineered Building:

AISC	Manual of Steel Construction, Allowable Stress Design
AISI	Cold-Formed Steel Design Manual
ASTM	American Society for Testing and Materials
AWS D1.1	Structural Welding Code
FM	Factory Mutual
FS TT-P	Federal Specification for Primer Coating, 664C
MBMA	Metal Building Systems Code of Standard Practice
CMR 780	Massachusetts State Building Code, Eight Edition
SSPCS	Structural Steel Painting Council Standards
UL	Underwriters Laboratory

1.07 DESIGN REQUIREMENTS

A. Building Structures:
   1. The building structure frame types shall be as follows:
      a. Single-span rigid frame (solid web or open web rafter) with straight or tapered sections as noted on Drawings and designed in accordance with AISC Type I construction. Column bases shall be designed as pin connected. Lateral resistance will be provided by the main rigid frame, portal frame and cross bracings as appropriate.
   2. Criteria and definitions shall be in accordance with MBMA Low Rise Manual, except criteria for seismic loads shall be in accordance 780 CMR State Building Code of the Commonwealth of Massachusetts 9th edition, with TI 809-04 and all other loads and load combinations in accordance with ASCE 7, whichever is more stringent.
   3. Design of structural steel sections and welded plate members shall be based upon the applicable specifications of AISC Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings as determined by the Manufacturer.
   4. Light-gage, cold-formed structural members and exterior coverings shall be designed based upon the applicable sections of AISI Specifications for the Design of Cold-Formed Steel Structural Members as determined by the manufacturer.
   5. The design of primary and secondary structural framing as well as roof and wall covering shall be per manufacturer's standard and shall be based upon the provisions of the specified code.

6. Bracing in the plane of the roof and vertical wall bracing shall be round rods or angle bracing as determined by the building manufacturer. Bracing shall be located such that it does not interfere with window or doors openings or minimum clear height requirements. In walls where cross bracing interferes with openings, portal braces or portal frames may be used.
7. Secondary framing girts type shall be as shown on drawings. Purlins shall be supported on top flange of the frame girders and shall be braced at quarter spans. Purlin bracing shall be full depth bracing or cross bracing providing support for both top and bottom flange of the purlins.
8. Design Loads:
   a. The dead load shall consist of the weight of all permanent construction such as roof, framing, covering members and all other materials of the building system.
   b. Collateral loads shall be applied to the entire structure to account for the weight of additional permanent materials other than the building system, such as sprinklers, mechanical systems, and electrical systems. This allowance does not include the weight of hung equipment weighing 50 pounds or more. Equipment loads of 50 pounds or more shall be shown on the shop drawings and the structural members shall be strengthened as required. The Contractor is responsible for providing the building manufacturer the magnitude and approximate location of all concentrated loads greater than 50 pounds before design of the building commences.
   c. Uniform roof live loads, including maintenance traffic and construction loads.
   d. In addition to prescribed roof live loads, a minimum design concentrated load of 300 pounds shall be used to simulate a construction load on roof decking. The concentrated load shall be applied at the decking. The undeformed shape of the decking shall be used to determine the section properties.
   e. Design roof snow loads in accordance with the State Building Code, 780 CMR 9th edition.
   f. Design mezzanine floor live loads - 150 psf.
   g. Bridge Crane: 10 ton (20,000 pound) capacity.
   h. Design wind load in accordance with the State Building Code, 780 CMR 9th edition.
   i. Seismic design data in accordance with the State Building Code, 780 CMR 9th edition.
   j. Include a 10 psf collateral load for sprinklers, light fixtures, etc.
9. Deflections
   a. Live Load: Roof Purlins - Span/240, unless supporting the crane girder
      Roof Beams or Girders - Span/240, unless supporting the crane girder
      Mezzanine and Second Floor Beams or Girders - Span/360
   b. Lateral: Wind - H/360
      Seismic - H/200
10. Connections:
   a. Bolted moment connections shall be designed in accordance with accepted industry standards utilizing flush plate design methods or extended plate design methods as determined by the manufacturer.

b. Field connections, made with high strength bolts, shall be made in accordance with the AISC Specification For Structural Joints Using ASTM A325 or A490 bolts. Recommended method of installation, "Turn-of-Nut" method.

11. Foundations:
    a. Foundation loads, anchor bolt diameters, embedments and anchor bolt patterns shall be determined by the building manufacturer. Footing sizes, and method of transferring lateral and uplift forces from the anchor bolts to the concrete foundation shall be determined by the foundation engineers and as noted on Drawings.
    b. Building manufacturer shall supply all anchor bolts (quantities and sizes) and templates for installation by Contractor into concrete.
12. The design analysis shall be done by a registered Professional Engineer, registered in the Commonwealth of Massachusetts, experienced in design of this work and shall include complete calculations for the building, its components, and the foundations. Foundations shown on the drawings are based on loads derived from a representative set of similar building types. Formulas and references shall be identified. Assumptions and conclusions shall be explained, and cross-referencing shall be clear. Wind forces on various parts of the structure, both positive and negative pressure, shall be calculated with the controlling pressure summarized. Lateral forces due to seismic loading shall be calculated and tabulated for the various parts and portions of the building.
    Computer programmed designs shall be accompanied by stress values and a letter of certification, signed by a Professional Engineer registered in the Commonwealth of Massachusetts, stating the design criteria and procedures used and attesting to the adequacy and accuracy of the design. A narrative of the computer program delineating the basic methodology shall be included.

B. Metal Siding and Roofing:
    1. Metal siding and roofing shall be designed for loads in accordance with the specified code.
    2. All metal siding and roofing shall be designed, fabricated and erected to withstand the loading conditions without loss of weather tightness, without permanent distortion and without damage to any part of the installation.

PART 2 - PRODUCTS

2.01 STRUCTURAL

A. Structural steel shall conform to ASTM A 992, ASTM A529, ASTM A572, and/or ASTM A36.

B. Cold-formed structural steel shall conform to ASTM A570 or A607 and shall have a minimum yield strength of 50 KSI.

C. Bolts: Bolts and nuts shall conform to ASTM A325 for high strength bolts, and ASTM A307 for common bolts.

D. Headed Anchor Bolts: Anchor bolts shall be designed using allowable loads for ASTM F 1554, Grade 36 threaded parts per AISC.

E. All primary and secondary frame members, bolts and anchor bolts shall be prime painted in accordance with industry standards.

2.02 COMPOSITE FLOOR DECK

A. Composite Steel Floor Deck: Fabricate panels, with integrally embossed or raised pattern ribs and interlocking side laps, to comply with "SDI Specifications and Commentary for Composite Steel Floor Deck," in SDI Publication No. 30, with the minimum section properties indicated, and with the following:
   1. Galvanized Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade 33 (230), G60 (Z180) zinc coating.
   2. The average rib width to height ratio shall be equal to or greater than 2.00.
   3. Side lap joints shall be overlapping or interlocking and of a type which can be button punched or welded.
   4. Ribs shall be 12 inches oc.
   5. Profile Depth: 1-1/2 inches (38 mm).
   6. Design Uncoated-Steel Thickness: 0.0474 inch (1.20 mm).
   7. Span Condition: Triple span or more.

B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.

C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 minimum diameter. Side lap can be welded.

D. Shear Connectors: ASTM A108, Grades 1015 through 1020, headed-stud type, cold finished carbon steel; AWS D1.1, Type B.

E. Adjusting plates:
   1. Adjusting plates or segments of deck units shall be provided in locations too narrow to accommodate full-size units. As far as practical, the plates shall be the same thickness and configuration as the deck units.

F. Closure Plates for Composite Deck:
   1. The concrete shall be supported and retained at each floor level.
   2. Provide edge closures at all edges of the slab of sufficient strength and stiffness to support the wet concrete, unless noted otherwise in the structural drawings.
   3. Metal closures shall be provided for all openings in composite steel deck ¼ inch and over.

G. Cover Plates to Close Panels:
   1. Cover plates to close panel edge and end conditions and where panels change direction or abut.
   2. Butt joints in composite steel deck may receive a tape joint cover.

H. Sheet Metal:
   1. Where deck is cut for passage of pipes, ducts, columns, etc., and deck is to remain exposed, provide a neatly cut sheet metal collar to cover edges of deck.
   2. Do not cut deck until after installation of supplemental supports.

I. Miscellaneous accessories, minimum .0358 inch thick, unless otherwise indicated.
   1. Saddles, .047 inch
   2. Butt cover plates
   3. Underlapping sleeves

J. Galvanizing Repair Paint:
   1. Touch-up paint for zinc-coated units shall be approved galvanizing repair paint (SSPC 20 Type I – Inorganic) with a high-zinc dust content.
   2. Welds shall be touched-up with paint conforming to MS DOD-P-21035.

2.03 ACCESSORIES

A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.

B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.

C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 minimum diameter.

D. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi, not less than 0.0359-inch design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.

E. Pour Stops and Girder Fillers: Steel sheet, minimum yield strength of 33,000 psi, of same material and finish as deck, and of thickness and profile indicated.

F. Column Closures, End Closures, Z-Closures, Cover Plates: Steel sheet, of same material, finish, and thickness as deck, unless otherwise indicated.

G. Sump Pans: Provide one of the following as directed by the roof drain subcontractor.
   1. Flat Sump Plate: Single-piece steel sheet, 0.0747 inch thick minimum, galvanized. For drains, cut holes in the field.

2. Recessed Sump Pans: Single-piece steel sheet, 0.0747 inch thick minimum, galvanized sheet steel with level bottoms and sloping sides to direct water flow to drain. Provide sump pans of adequate size to receive roof drains and with bearing flanges not less than 3 inches wide. Recess pans not less than 1-1/2 inches below roof deck surface unless otherwise shown or required by deck configuration. For drains, cut holes in the field.

H. Galvanizing Repair Paint: ASTM A 780; SSPC-Paint 20 or DOD-P-21035, with dry film containing a minimum of 94 percent zinc dust by weight.

I. Sealants, Mastics and Closures:
1. Tube sealant shall be a synthetic elastomer based material which becomes tack-free in less than 2 hours at 75 deg. F, but remains flexible. Service range shall be -30 deg. F to 160 deg. F.
2. Tape mastic shall be preformed butyl rubber based compound. Service range shall be -30 deg. F to 160 deg. F.
3. Panel closures shall be Ethylene-Propylene-Diene-Monomer or equivalent closed cell strips formed to match panel configuration.
4. Sealants, mastics and closures shall be applied in strict accordance with manufacturer's drawings and recommendations.

J. Framing at Overhead Doors:
1. Coordinate with Contractor installation of framing at rolling doors as shown on drawings.

2.04 INTERIOR LINER PANELS

A. Liner Panels: 36 inch wide net coverage, with 1-3/16 inch high major ribs with miner ribs spaced between the major ribs.
1. Material: AZ50 Galvalume coated steel.
2. Thickness: 28 gage, white, SMP (Silicone Modified Polyester) finish.
3. Length: Continuous from knee wall to eave.

PART 3 - EXECUTION

3.01 FABRICATION

A. Steel fabricators shall have been engaged in steel fabrication for the past 10 years, and shall have ICBO approval as a steel fabricator and must be a member of the Metal Building Manufacturers Association. Fabricators shall also have on staff a qualified Professional Engineer registered in the State of Massachusetts in charge on engineering.

B. Fabrication shall be based on approved drawings in accordance with AISC Code of Standard Practice.

C. All steel members shall be prefabricated into subassemblies of the largest practical size suitable for transportation, handling and field erection. Field cutting, welding and drilling shall be kept to the minimum.

D. Light gage cold formed sections shall be manufactured by precision roll or brake forming.

E. Structural steel shall be detailed and fabricated in accordance with the MBMA Code of Standard Practice.

F. The detailing and fabrication of anchor bolt assemblies shall be accordance with AISC.

G. All welders shall be AWS Certified in the positions and type of welding they will be performing during fabrication.

3.02 PAINTING

A. Shop primer shall be a nominal 1 mil. thick and conform to Federal Specifications TT-P-664c and TT-P-636c, all components.

B. Primary and secondary structural members and miscellaneous accessories shall be field painted (finish) in accordance with Section 09 90 10.

3.03 ASSEMBLY

A. General:
   1. Pre-engineered buildings shall be erected complete with all components and accessories in strict accordance with the building manufacturer's printed instructions and approved shop drawings.
   2. Erection shall be done by a contractor who has minimum of 5 years experience in the erection of pre-engineered buildings. The building shall be erected in accordance with the MBMA Code of Standard Practice and on the prepared foundations as indicated on the structural drawings.
   3. The building manufacturer shall assist in the supervision during the entire erection of the buildings.
   4. Install wall and roof panels in accordance with manufacturer's written instructions.
   5. Accessories for roofing or siding, necessary for a complete installation, and as shown, shall be furnished and installed with the roofing and siding. Cutouts and flashing shall be provided for vents, ventilator ducts, roof hatches and all other penetrations as shown and required. Joints shall be caulked as shown and as

required for a weathertight installation. Field-cut edges of roofing and siding, including penetrations, shall be touched up with manufacturer's coating compatible with sheet finish.

6. Building manufacturer shall provide all column and rigid frame anchor bolts and attachments to concrete walls, piers and footings.
7. Install insulation where shown on drawings.

B. Decking Installation, General:
1. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 30, manufacturer's written instructions, and requirements in this Section.
2. Locate deck bundles to prevent overloading of supporting members.
3. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.
4. Place deck panels flat and square and fasten to supporting frame without warp or deflection.
5. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.
6. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.
7. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.

C. Touch-Up Painting:
1. Structural steel connections and all areas damages subsequent to shop painting shall be repaired, cleaned, and touch-up painted, prior to roofing/siding installation. Use cold applied zinc rich primer.
2. Damaged or stained areas of roofing, siding, and accessories shall be touched up with the manufacturer's coating in accordance with manufacturer's current published instructions.

3.04 FLOOR-DECK INSTALLATION:

A. Fasten floor-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated and as follows:
1. Weld Diameter: 3/4 inch, nominal.

B. Weld Spacing: Weld edge ribs of panels at each support. Space additional welds an average of 12 inches apart, but not more than 18 inches apart. Alternative means of fastening metal deck to supporting steel will be by the use of or appropriate powder actuated fastener.

C. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of half of the span or 36 inches, and as follows:
   1. Fasten with a minimum of 1-1/2-inch-long welds or self tapping screws.

D. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches.

E. Shear Connectors: Use automatic end welding or headed-stud shear connectors according to AWS D1.1 and manufacturer's written instruction. Use welding washers as condition warranted.

F. Pour Stops and Girder Fillers: Weld steel sheet pour stops and girder fillers to supporting structure according to SDI recommendations, unless otherwise indicated.

G. Floor-Deck Closures: Weld steel sheet column closures, cell closures, and Z-closures to deck, according to SDI recommendations, to provide tight-fitting closures at open ends of ribs and sides of deck.

END OF SECTION

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SECTION 13 44 13

MEZZANINE SAFETY GATE

PART 1 - GENERAL

1.01 SUMMARY

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 1 – GENERAL REQUIREMENTS, which are hereby made a part of this Section of the Specifications.

B. Elevated access protection.

1.02 RELATED SECTIONS

A. Section 03 30 00, CAST IN PLACE CONCRETE.

B. Section 13 34 19, PRE-ENGINEERED BUILDING.

1.03 REFERENCES

A. OSHA 29 CFR 1910.29 - Guarding floor and wall openings and holes.

B. ANSI MH28.3 - Design, Manufacture, and Installation of Industrial Steel Work Platforms.

1.04 SUBMITTALS

A. Submit in accordance with Section 01 33 00, SUBMITTALS.

B. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Installation methods.

C. Shop Drawings: Complete details of entire mezzanine gate layout, showing member sizes and part identification, fasteners, anchors, fittings and evidence of compliance with structural performance requirements.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Experience manufacturing portable railing systems.

B. Installer Qualifications: Crew capable of positioning and installing fall protection system according to manufacturers instructions.

1.06 DELIVERY, STORAGE AND HANDLING

A. Store and maintain products in accordance with the manufacturer's printed recommendations.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. LedgeGuard Mezzanine Safety Gate System as manufactured by Garlock Safety Systems, or approved equal.

2.02 DESIGN REQUIREMENTS

A. Structural Performance: Comply with requirements of 780 CMR 9th edition, state, and federal codes.

B. Structural performance of top gate rails and supports:
   1. Capable of withstanding a concentrated load of 200 pounds, applied to the top rail at any point and in any direction.

C. Structural performance of railing infill:
   1. Capable of withstanding a horizontal concentrated load of 200 pounds, applied to one foot (30.5mm) square area at any point on the infill.
   2. Infill includes panels, intermediate rails, posts and other elements.
   3. Design need not provide for infill loads to be applied concurrently with top rail loading.

2.03 EQUIPMENT

A. Mezzanine Safety Gate System: Two-gate system for protecting elevated access points during material loading and unloading.
   1. Meets OSHA 1910.23(c).
   2. Rails: 1-5/8 inch HREW steel tubing.
   3. Depth: 63 inches.
   4. Height: 42 inches.

5. Width: 57 inches.
6. Mid-rail: weld to posts at 21 inches below top rail.
7. Options:
   a. Toeboard.
   b. Ground pole.
8. Holes: Holes for permanent mounting and securing base.
9. Finish: Epoxy powder coated safety yellow.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

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

3.02 PREPARATION

A. Clean surfaces thoroughly prior to installation.

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

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Before installation, inspect all parts to insure no damaged parts are used.

C. Railing must be secured to base with bolts indicated on the shop drawings.

D. Anchor base mounts to concrete substrate with expansion bolts or to steel edge angles with appropriate anchors bars.

3.04 PROTECTION

A. Protect installed products until completion of project.

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

END OF SECTION

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SECTION 21 00 00
Fire Protection Sprinkler Systems

(Filed Sub-Bid)

1.1 DESCRIPTION

A All of the Contract Documents, including General and Supplementary conditions and Division 0 – Bidding Documents, Contract Forms and Conditions of the Contract and Division 1 – General Requirements, apply to the work in this Section.

B Carefully examine all the Contract Documents for requirements which affect the work of this Section. The exact scope of this Section cannot be determined without a thorough review of all specifications sections and other Contract Documents.

C Where referred to, Standard Specifications, Recommendations of Technical Societies, and/or Manufacturer's Associations, plus Codes of Federal, State, and Local Agencies shall include all amendments current as of date of issue of these specifications.

1.2 REQUIREMENTS FOR SUBMITTING FILED SUB-BID

A. Sub-bids shall be submitted for the Work of this Section in accordance with the provisions of M.G.L. c.149 §§44A-J The time and place for submission of sub-bids are set forth in the **Advertisement.** The procedures and requirements for submitting sub-bids are set forth in the **Instructions to Bidders.**

B. Sub-bidders must be DCAMM Certified in the listed trade and shall include a Current DCAMM sub-bidder Certificate of Eligibility and a signed DCAMM Sub-bidder’s Update Statement with the bid

C. Specification requirements for the Filed Sub-bid "Fire Protection Sprinkler Systems" include all of the following listed Specification Sections in their entirety.

SECTION 21 00 01 - FIRE PROTECTION

D. The Work of this Section is shown on Drawings
TS-001, R-101, R-102, A-001, A-201, FP-101, FP-102, FP-201

E. SUB-SUBS

1. Sub-sub bids are required for this Section. Sub-Bidders shall include the appropriate information for the list of sub sub-bid Class of Work noted below in this paragraph. NOT APPLICABLE

2. If the Filed Sub-Bidder customarily performs the above Work with its own workforce, the Sub-Bidder should list its own name and trade and leave the dollar amount blank.

3. If the Filed Sub-Bidder does not customarily perform the Classes of Work with its own workforce, the Sub-Bidder should list the name of the contractor performing the work, the trade and insert a dollar amount.

END OF SECTION

SECTION 210001

FIRE
PROTECTION
(Filed Sub-bid)

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. Attention is directed to the general and supplementary conditions and Division 1 including all sub-divisions thereof as listed in the table of contents, which are hereby made a part of this Section.

B. All work shall comply with all federal, state and local codes and any other authorities having jurisdiction including any special requirements of the Owner and/or Architect.

1.2 REQUIREMENTS FOR SUBMITTING FILED SUB-BID

A. The Conditions of the Contract and Division 1, General Requirements shall be part of this section

B. Sub-bids shall be submitted for the Work of this Section in accordance with the provisions of M.G.L. c.149 §§44A-J. The time and place for submission of the sub- bids are set forth in the ADVERTISEMENT. The procedures and requirements for submitting sub-bids are set forth in the INSTRUCTIONS TO BIDDERS.

C. The work of this Section is shown on Drawings **TS-001, A-001, FP-101, FP-102, and FP-201**.

D. Sub-sub-bids are not required for this section. Paragraph E of the Form for sub-bid shall be left blank or marked N/A.

1.3 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. Furnish all labor, materials, tools, equipment, supervision, services, and incidentals necessary for the installation of a complete "wet pipe" sprinkler system

complete and ready for standard operation. Systems shall be installed in all spaces, except where specifically noted otherwise. The systems shall include all alarm valve, backflow preventer, OS&Y or butterfly valves, check valves, sprinkler heads, fire department connection, and such other standard accessories as are necessary for a complete, approved system. The Fire Protection Subcontractor shall obtain all necessary permits, file all necessary drawings, obtain all approvals, and pay all fees required to complete the work of this Section.

2. The Fire Protection Subcontractor shall furnish, install, move, and maintain in safe condition all rigging, hoisting, scaffolding, and staging as required for his use and for the proper execution of his work.

3. This Contractor shall be responsible for all seismic control for the entire sprinkler piping system and equipment.

4. The Fire Protection Subcontractor shall begin work at the flange in the first floor sprinkler closet. Coordinate exact connection location & elevation of the flange with the Site Contractor.

6. This Contractor is responsible for sleeving all penetrations associated with the respective work. This Contractor is also responsible for coring all holes up to and including 1-1/2" diameter. This Contractor is responsible for firestopping all holes related to their work.

B. Design Criteria: Pipe sizing and sprinkler head layout shown on the Drawings is provided to indicate a suggested pipe routing, zoning, and sprinkler head location and shall not be used for estimating purposes. Location of piping and heads shall be coordinated with all other trades. Actual pipe sizing, types of heads, and layout shall be based on a hydraulically designed system in accordance with the requirements of NFPA 13, the Montague Fire Department, and the Insurance Underwriter. Location of sprinkler heads, in relation to the ceilings and walls and spacing of the heads, shall not exceed that permitted by NFPA 13 of the light occupancy specified (ordinary hazard occupancies in Storage Rooms, Mezzanine, Shop, Vehicle Repair Garage, Vehicle Storage Garage and Electrical Rooms). The Fire Protection Subcontractor shall prepare working drawings and hydraulic calculations per NFPA 13, by a registered Fire Protection Engineer, and shall obtain Montague Fire Department and Insurance Underwriter approval prior to start of work. The Fire Protection Subcontractor shall coordinate a water flow test with the local water department/DPW to obtain current information for the calculations and design. Coordinate work of this Section with all trades to avoid interference with ductwork, HVAC and plumbing piping, electrical work, structure, etc. Final sprinkler head locations shall be subject to Architect-Engineer's approval. The number of heads and pipe sizes may be increased or reduced due to hydraulic calculations or the installation of revised heads, provided the revised heads are U.L. listed and meet NFPA 13 and Insurance Underwriters' criteria. Additionally, all heads shall be centered with ceiling tile layout, except where indicated

otherwise on the Drawings. Standpipes are not required in this building due to the building height.

C. ALTERNATES:

Special attention is called to the fact that it shall be the responsibility of all the General and Subcontractors to thoroughly examine all the alternates and evaluate for themselves as to whether or not these alternates in any way affect their respective sections. In the event that a contractor feels that any alternate(s) do reflect a cost difference, additional or a deduction, in his bid proposal, then he shall stipulate his sum and/or sums under the proper alternate(s) as provided for in the bid proposals. Failure to do so will in no way relieve the hereinbefore stated contractors of their responsibilities regardless of what alternate(s) are selected and no extra cost will be charged to the Owner. Refer to DIVISION 1, SECTION 01100, ALTERNATES, for list and description of Alternates.

D. Reference to Drawings: The work of this section is shown on drawings FP-101, FP-102 and FP-201.

E. Related Work: The following items are not included in this Section and will be performed under the designated Sections:

1. SECTION GENERAL CONDITIONS OF THE CONTRACT.

    a. Cutting and drilling of holes larger than 1-1/2 in. diameter or square.
    b. Patching of all holes.

2. SECTION - WATER SYSTEMS.

    a. Water from the street into Sprinkler Closet and post indicator valve (if required) or exterior water gate valve with curb box.
    b. Site distribution, including fire hydrants.

3. SECTION - FIRE SAFING.

4. SECTION - PAINTING.

    a. All painting.

5. SECTION 16000 - ELECTRICAL WORK.

    a. Wiring of fire alarm devices and flow switches provided under this Section.
    b. All electrical power and control wiring, line or low voltage.

F. Extent: The work required under this Section, without limiting the generality thereof,

includes the furnishing of all labor, materials, equipment, and services necessary for, and reasonably incidental to, the complete installation of all piping, valves, sprinklers, and all other materials, equipment, and labor necessary, whether or not such items are specifically indicated on the Drawings or in the Specifications, to complete the fire protection systems in all respects ready for continuous and trouble free operation.

G. Intent: It is the intent of the Contract Documents to include all work and materials necessary for erecting complete, ready for continuous use, all fire protection systems as shown on the accompanying Drawings or as hereinafter described. These Drawings shall be taken in a sense as diagrammatic; sizes of pipes, etc., and methods of running them are shown, but it is not intended to show every offset and fitting, nor every structural difficulty that will be encountered during the installation of the work.

1.4 CODES, STANDARDS AND REFERENCES

A. All materials and workmanship shall comply with the latest editions of all applicable Codes, Local and State Ordinances, Industry Standards and Regulations.

B. The Fire Protection Subcontractor shall notify the Architect/Engineer of any discrepancies between the Contract Documents and applicable Codes, Standards, etc…

C. In the event of a conflict, the most stringent requirements shall apply.

D. The following Codes, Standards and References shall be utilized as applicable:

1. Massachusetts State Building Code, 9th Edition.
2. National Electric Code (NEC).
3. Environmental Protection Agency (EPA).
4. Commonwealth of Massachusetts Department of Environmental Protection (DEP).
5. Local Ordinances, Regulations of Town of Montague.
6. National Fire Protection Association (NFPA).
7. Insurance Services Organization (ISO).
8. American National Standards Institute (ANSI).
9. American Society of Mechanical Engineers (ASME).
10. American Society for Testing and Materials (ASTM).
11. American Welding Society (AWS).
12. Commercial Standards, U.S. Department of Commerce (CS).
13. National Electrical Manufacturers Association (NEMA).
14. American Gas Association (AGA).
15. Underwriters' Laboratories, Inc. (UL).

1.5 SYSTEM DESCRIPTION

A. Heat produced from a fire melts the fusible link or glass bulb on a single sprinkler head or group of sprinkler heads causing the sprinkler(s) to open. Water from the water filled pipe is discharge immediately from the sprinkler head(s) to control the fire. The fire department may pump into the system via the fire department connection to supplement the system. Sprinkler system water flow alarms activate upon system flow and indicate to the FACP an alarm condition. The sprinkler(s) continue to flow water until manually shut off.

1.6 SUBMITTALS

A. Refer to Section - SUBMITTALS for submittal provisions and procedures.

B. Submit for approval, within thirty (30) days after signing the Contract and prior to the submission of any shop drawings, an itemized list of manufacturers of material and equipment and of Subcontractors proposed to be used under this section

C. After approval of the list, submit for review a minimum of five (5) sets of detailed drawings or electronic submittals in PDF format. The architect shall return one (1) copy to the G.C. for them to copy and distribute. The G.C. shall coordinate the shop drawing submittals. All shop drawings for equipment submitted for review shall include Specifications, including type of materials, operating pressures, capacities, performance and power requirements to determine compliance with Contract Documents. All data submitted shall be complete for all equipment and shall apply only to this specific project. Submit data sheets for the following:

1. Sprinkler fabrication drawings complete with hydraulic calculations.
2. Piping and appurtenances.
3. Grooved joint couplings and fittings.
4. Indicators, alarms, gauges, switches, etc.
5. Sprinkler heads and cabinets.
6. Double check valve backflow assemblies.
7. Flow switches.
8. Tamper switches.
9. Wall Mounted Fire Department Storz Connection.
10. Valves, alarm test modules.
11. Alarm Check Valve.
12. Gate valves or Butterfly Valves.
13. Piping and fittings.
14. Wet pipe alarm valve with trim.
15. Electric alarm bell and strobe alarms.

16. Vibration and seismic control.

D. Regardless of any information included in the shop drawing submitted for review, the requirements of the Drawings and Specifications shall not be superseded in any way by the shop drawing review.

E. Each submittal shall be reviewed, stamped and certified prior to submission to the Architect. Such certification shall be made by the Owner or Corporate Office of the Contractor, or by a person duly authorized by the Owner to sign binding agreements for the Contractor. The certification shall state that the data and details contained on each shop drawing, layout drawing, catalog data and brochure have been reviewed by the Contractor and that it complies with the Contract Documents in all respects. Shop drawings, layout drawings, catalog data and brochures will not be reviewed and will be returned to the Contractor unchecked unless they are certified.

F. It is intended that the Contractor submit complete and accurate data at the first submission. If the shop drawing is returned marked “Resubmit” or “Not Accepted”, only one (1) additional submission will be permitted.

G. Equipment shall be of proper size for its allotted space. Equipment shall be disassembled as required, without invalidating the manufacturer’s warranty, so that it can be installed through regular window, door, and/or louver openings.

H. The shop drawings and manufacturer’s data shall be submitted in a timely manner sufficiently in advance to give ample time for checking, correcting, resubmitting and rechecking if necessary. No claim for delay will be granted for failure to comply with this requirement.

I. A minimum period of two (2) weeks, exclusive of transmittal time, will be required in the Engineer’s office each time shop drawings, layout drawings, catalog data and brochures are submitted or resubmitted for review. The time period shall be considered by the Contractor when scheduling his work.

J. Fabrication drawings and hydraulic calculations shall be submitted and stamped approval by the Montague Fire Department and I.S.O. prior to submitting to the Architect for review. Fabrication drawings and hydraulic calculations shall bear the seal of registration of a qualified registered professional fire protection engineer.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Installation and alterations of fire protection: piping, equipment, specialties, accessories and repair and servicing of equipment shall be

performed only by a qualified installer. The term "Qualified" means experienced in such work ("Experienced" shall mean having a minimum of 5 previous projects similar in size and scope to this project), familiar with all precautions required, and has complied with all the requirements of the authority having jurisdiction. Upon

request, submit evidence of such qualifications to the Engineer. Refer to Division 1 Section: "Definitions and Standards" for definition for "Installers".

B. Qualifications for Welding Processes and Operators: Comply with the requirements of AWS D10.9, "Specifications for Qualifications of Welding Procedures and Welders for Piping and Tubing, Level AR-3".

C. All piping and equipment running within trusses must be supported from top chord of truss at panel point. For any alternate configurations or for heavy pieces of equipment coordinate fully with structural engineer for support location before installation.

D. All grooved joint couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components.

   a. All castings used for coupling housings, fittings, valve bodies, etc., shall be date stamped for quality assurance and traceability.

E. Regulatory Requirements: Comply with the requirements of the following codes:
   a. NFPA 13 - Standard for the Installation of Sprinkler Systems, 2013 Edition.
   b. NFPA 24 - Standard for the Installation of Private Fire Service Mains and Their Appurtenances 2002 Edition.
   c. NFPA 30 - Flammable and Combustible Liquids Code 2003 Edition.
   d. NFPA 1963 - Standard for Fire Hose Connections 2003 Edition.
   e. 527 CMR – Board of Fire Prevention Regulations.
   f. 780 CMR – Massachusetts State Building Code, Ninth Edition.
   g. UL Compliance: Fire protection system materials & components shall be Underwriter's Laboratories listed and labeled and for the application anticipated.

1.8 DELIVERY, STORAGE, AND HANDLING

A. The Fire Protection Subcontractor shall provide for the delivery of all his materials and fixtures to the building site when required so as to carry on his work efficiently and to avoid delaying his work and that of other trades.

B. The Fire Protection Subcontractor shall, at all times, fully protect his work and materials from injury or loss by others. Any injury or loss, which may occur, shall be made good without expense to the Owner. The Fire Protection Subcontractor

shall be responsible for the proper protection of all his materials until the Owner accepts the building.

1.9 GUARANTEE/WARRANTY

A. The Fire Protection Subcontractor shall and hereby does warrant that all work executed and all equipment furnished under this Section shall be free from defects of workmanship and materials for a period of one (1) year from date of final acceptance of this work. The Fire Protection Subcontractor further agrees that he will, at his own expense, repair and replace all such defective work and all other work damaged thereby which becomes defective during the term of the Guarantee-Warranty.

1.10 RECORD DRAWINGS

A. Refer to SECTION - CONTRACT CLOSEOUT for Record Drawings.

B. Record Drawings shall reflect all changes from the Contract Drawings whether by Change Order or by field conditions. Principal dimensions shall be indicated of concealed work, fire protection lines, valves, and zone flow switches.

C. Provide as-built record drawings in AutoCAD 2004 format or newer version on a CD to the G.C. at the completion of the project.

1.11 OPERATING INSTRUCTIONS

A. At the time of final acceptance, the Fire Protection Subcontractor shall furnish three (3) sets of complete instructions for the repair, maintenance, and operation of the system.

B. The Fire Protection Subcontractor shall instruct and fully demonstrate to such person or persons as the Architect-Engineer and/or Owner may designate, regarding the care and use of the fire protection systems and all apparatus pertaining thereto.

1.12 CUTTING AND PATCHING

A. Cutting of openings greater than 1-1/2” diameter, and patching of all openings and holes required for the installation of fire protection in the building shall be performed by the General Contractor. All work and materials shall be installed in such a manner and at such time to keep cutting and patching to a minimum. The

Fire Protection Subcontractor shall check location for openings and error, due to failure to coordinate work with other Divisions, shall be the responsibility of the Fire Protection Subcontractor failing to coordinate, which shall make the corrections at his own expense.

B. Work shall include furnishing and locating sleeves or inserts required before the new walls are built, or be responsible for the cost of cutting and patching required for pipes where sleeves were not installed, or where incorrectly located. The Fire Protection Subcontractor shall do all drilling required for the installation of hangers.

C. The General Contractor or appropriate tradesmen shall perform patching of all holes after installation of piping or equipment.

D. All piping, cutting, and threading shall be done in a location approved by the Architect-Engineer.

E. No pipe cutting or threading shall be done in areas where completed concrete floor slab is to remain as finished or be painted later. Should this area be necessary, the Fire Protection Subcontractor shall cover the entire working area with canvas tarpaulins in an approved manner.

1.13 CLEANING

A. The Fire Protection Subcontractor shall thoroughly clean and flush all piping and clean all equipment of all foreign substances inside and out before being placed in operation.

B. If any part of a system should be stopped or damaged by any foreign matter after being placed in operation, the system shall be disconnected, cleaned, and reconnected at no additional cost to the Owners.

C. During the course of construction, all pipes shall be capped to insure adequate protection against the entrance of foreign matter.

D. At all times, keep the premises clear of undue accumulation of rubbish.

E. Upon completion of all work under the Contract, the Subcontractor shall remove from the premises, all rubbish, debris, and excess materials created by his employees and shall be responsible for disposal of it.

1.14 COORDINATION OF TRADES

A. The Fire Protection Subcontractor shall give full cooperation to the Subcontractors of other trades, and shall furnish any information necessary to permit the work of all trades to be installed satisfactorily and with least possible interference or delay.

B. In areas where conflicts may occur, if so directed by the Architect-Engineer, this Subcontractor shall prepare composite sketches at a suitable scale, not less than ¼" = 1'- 0", clearly showing how his work is to be installed in relation to the work of other trades.

C. Piping and other equipment shall not be installed in congested and possible problem areas by this Subcontractor without first coordinating the installation of it with other trades and the Architect-Engineer. This Subcontractor, at his own expense, shall relocate all uncoordinated piping and other equipment installed should they interfere with the proper installation and mounting of electrical equipment, HVAC, ductwork, piping and equipment, plumbing piping, hung ceilings, and others; structural finish to be installed by other trades.

D. This Subcontractor shall coordinate the elevations of all piping and equipment in hung ceilings for the installation of recessed lighting fixtures, duct boxes, etc. Conflicts shall be brought to the attention of the Architect-Engineer for a decision before the piping and/or equipment of other trades is installed.

E. In areas where, due to construction conditions, more than one trade is required to use common openings in chases, shafts and sleeves for the passage of conduits, raceways, piping, ductwork and other materials, this Subcontractor must plan and locate the positions of equipment to be furnished under this Section so that all items including piping and/or equipment of other trades may be accommodated within the space available. Location and positioning shall be done prior to installation of it and to the satisfaction of the Architect-Engineer.

F. This Subcontractor, before installing his work, shall see that it does not interfere with the clearances required for finished columns, pilasters, partitions or walls, as shown on the Contract Architectural or Structural Drawings showing foundations, floor plans, roof plans and details.

G. Piping work that is installed under this Contract, which interferes with the architectural design or building structure, shall be changed as directed by the Architect-Engineer, and this Subcontractor at no additional cost shall pay all costs incidental to such changes to the Owner.

1.15 COORDINATION DRAWINGS

A. This Subcontractor shall be responsible for preparing Coordination Drawings to coordinate his work with all other trades, indicating pipe locations and floor to

center line elevations.

B. The background plans for the Coordination Drawings shall be prepared by the HVAC Subcontractor. Architect-Engineer Drawings shall be made available in AutoCAD format for the purpose of Coordination Drawings.

C. This Subcontractor shall submit fire protection Drawings and hydraulic calculations to the Architect-Engineer and the Montague Fire Department for approval.

1.16 PERMITS, FEES, RULES AND REGULATIONS

A. Refer to Bidding and Contracting Requirements, including Section, GENERAL CONDITIONS and Section, SUPPLEMENTARY CONDITIONS, for requirements all of which shall be included as part of this Specification.

B. Give the proper Authorities all-requisite notices or information relating to the work under this Section. Obtain and pay for all fees, licenses, permits and certificates. Comply with the rules and regulations of all Local, State and Federal Authorities having jurisdiction, the Codes, Standards, recommended practices and manuals of the National Fire Protection Association, I.S.O., the Montague Fire Department and the Public Utilities Companies serving the building.

1.17 CERTIFICATES OF APPROVAL

A. Upon completion of all work, furnish, in duplicate, certificates of inspections.

1.18 SEISMIC RESTRAINTS

A. Installation of Fire Protection equipment, accessories and components shall be in accordance with the Seismic Requirements identified in the Massachusetts State Building Code, Ninth (9^{th} Edition) and NFPA 13 (2013 Edition).

PART 2 - PRODUCTS

2.1 MATERIALS

A. Piping:

1. Unless otherwise noted, piping in general shall include all piping above ground

from the blank flanged outlet provided in the Mechanical Room by the Sitework Subcontractor.

2. Piping above ground and within the building for the wet pipe system shall conform to all requirements of NFPA 13 and shall be as follows:

   a. Piping and fittings outside of the foundation wall to the inlet of the backflow preventer shall be ductile iron, (cement lined), or cut-grooved end galvanized pipe and fittings.

   b. All EXPOSED sprinkler piping, subject to vandalism (Stair Halls and similar areas), shall be Schedule 40 black steel pipe with cast-iron flanged or screwed fittings, cut-grooved Schedule 40 black steel pipe or welded, suitable for 175 PSI working water pressure.

   c. All CONCEALED sprinkler mains (above acoustical ceiling tiles and plaster ceilings and EXPOSED sprinkler piping in the Mechanical Room & Sprinkler Room downstream of alarm check valve, shall be Schedule 40 or Schedule 10 electric resistance welded light wall, steel pipe with rolled grooved ends, for piping 1-1/2 in. and larger, complete with suitable couplings and fittings for rolled grooved end steel pipe.

   d. All CONCEALED piping and all EXPOSED sprinkler piping in the Boiler Room, 1-1/2 in. and smaller, shall be Schedule 40 black steel pipe with screwed fittings.

   e. All piping on the outlet side of the backflow preventer and up to the alarm valves shall be cut grooved Schedule 40 black steel pipe and fitting or flanged pipe and fitting.

   f. Piping for water motor gong shall be galvanized pipe with screwed fittings.

   g. Schedule 10S stainless steel pipe with Victaulic Vic-Press ® fittings and couplings may be used in lieu of Schedule 40 pipe with screwed fittings. The Vic-Press ® shall be UL listed and FM approved for fire protection services to 175 psig.

3. Installation-Ready™ fittings for Schedule 40 or 10 grooved end steel piping in fire protection applications sizes NPS 1-¼ thru 2½. Fittings shall consist of a ductile iron housing conforming to ASTM A-536, Grade 65-45-12, with Installation-Ready™ ends, orange enamel coated. Fittings complete with pre-lubricated Grade “E” EPDM Type ‘A’ gasket; and ASTM A449 electroplated steel bolts and nuts. System shall be UL listed for a working pressure of 300 psi and FM approved for working pressure 365 psi.

4. Wherein before specified, piping systems shall be installed using mechanical pipe couplings of a bolted or mechanical locking device-type, with a central cavity design pressure-responsive gasket along with mechanical pipe fittings, flanges and grooved end valves and shall be approved for fire protection services. All grooved components shall be U.S. made and shall be approved by a single manufacturer and be installed per manufacturer's published literature.

    a. Rigid type couplings shall be ASTM A395 and A536 ductile iron, complete with angle pattern bolt pads to provide rigidity and support and hanging requirements corresponding to NFPA 13, fully installed at visual pad-to-pad offset contact. (Couplings that require exact gapping at specific torque ratings are not permitted.). Gaskets shall be EPDM-Type A.

        1. 1-1/4” through 12”: Installation-Ready, for direct stab installation without field disassembly. Victaulic Style 009-EZ.

    b. Flexible Type couplings shall be ASTM A395 and A536 ductile iron, for use in locations where vibration attenuation and stress relief are required, and for
    seismic applications in accordance with manufacturer’s recommendations. Victaulic Installation-Ready Style 177 or Style 75 or 77.

    c. Fittings shall be ASTM A 395 and A536 ductile iron, short pattern with flow equal to standard pattern. Victaulic FireLock™.

        1. Where FireLock™ pattern is not available, Victaulic UL listed and FM approved standard fittings may be used.

    d. Gaskets:

Fire Protection Service	Temp. Range	Gasket Recommendation
Dry Systems	Ambient	FlushSeal®, Grade EPDM, Type A
Freezer Applications	-40°F to 0°F	FlushSeal®, Grade L, Silicone
Water/Wet Systems	Ambient	Grade EPDM, Type A

    e. All grooved components shall be U.S. made and shall be by a single manufacturer and be installed per manufacturer's published literature. Tools used for preparation of pipe shall be of the same manufacturer as the grooved components.

        1. All castings used for coupling housings, fittings, valve bodies, etc., shall be date stamped for quality assurance and traceability.

5. Flexible Piping Systems (Optional)

a. Contractor shall provide flexible piping connection to sprinkler heads for both suspended and sheetrock ceiling. The bracket shall allow installation before the ceiling tile is in place. All flexible piping systems shall be UL Listed and FM Approved and suitable for their intended use.
b. All flexible piping connections to include a union threaded connection (no required welding), fully welded (non-mechanical fittings), or Victaulic FireLock IGS Groove Style 108 coupling for connection to branch-line piping, braided, leak- tested sprinkler drop with a minimum internal corrugated hose diameter of one inch (1"); and a one-piece multi-port ceiling bracket with removable attachment hub and self-securing integrated snap-on clip-ends, for attachment to ceiling grid without the need for a screw fastener.
c. The drop shall include a UL approved Series AH1 with 3" bend radius; AH2 or AH2-CC braided hose with a bend radius to 2" to allow for proper installation in confined spaces.
d. Union joints shall be provided for ease of installation.
e. The flexible drop shall attach to the ceiling grid using a one-piece open gate Series AB1 or AB2 bracket.
f. The braided drop system is UL listed for sprinkler services to 175 psi (1206 kPa) and FM Approved to 200 psi (1380 kPa).

g. Acceptable manufacturer:

1) VicFlex as manufactured by Victaulic Company of Easton, PA USA (610) 559-3300 or Fax (610) 250-8817 in lengths of 2 feet to 6 feet.

6. Where piping penetrates through walls, floors, and ceilings, the Fire Protection Subcontractor shall install pipe sleeves, complete with approved type fire safing at both ends.

B. Valves:

1. Gate valves shall be outside screw and yoke type, iron body with brass trim. They shall be Underwriters' Laboratories, Inc. listed and Factory Mutual approved and shall be designed for 175 pounds water working pressure. Screwed end gate valves shall be bronze and shall conform to Federal Specification WW-V-51. Grooved end gate valves shall be Victaulic Series 771. Check valves shall be of a type having ductile iron body, brass, PPS (Polyphenylene Sulfide) coated, or nickel seat with brass, aluminum bronze, or elastomer encapsulated ductile iron discs, clearway swinging, designed for 250 pounds water working pressure, and shall be listed by Underwriters' Laboratories, Inc. and Factory Mutual approved. Grooved end check valves shall be Victaulic Series 717. Screwed end angle, check, and globe valves shall be bronze and shall conform to Federal Specification WW-P-501. If alarm valves are of a make or type incorporating a removable ring, diaphragm or a

clapper facing, the Fire Protection Subcontractor shall furnish one (1) extra such item for each riser assembly.

2. In lieu of 2-1/2 in. through 6 in. OS&Y gate valves at flow control stations, the Fire Protection Subcontractor has the option, where allowed by NFPA, of installing grooved-end butterfly valves with factory installed internal tamper switches and weatherproof actuator, UL listed and FM approved, or equal by Victaulic Co. Series 705. Valve shall include a pressure-responsive elastomer seat and stainless steel stem. (Stem shall be offset from the disc centerline to provide complete 360-degree circumferential seating.).

3. In lieu of 2-1/2 in. and smaller OS&Y gate valves at floor control stations, the Fire Protection Subcontractor has the option of installing Victaulic Co's grooved-end butterfly valves Series 705 or ball valves Series 728 with factory installed internal tamper switches and weatherproof actuator, UL listed and FM approved, or equal by Milwaukee Valve Co.

4. Alarm check valves shall be approved vertical type for wet systems, complete with retard chamber, pressure switch, water motor gong, drain valve, pressure gauges, and other required trimmings. Alarm valve internal components shall be replaceable without removing the valve from the installed position. Grooved end alarm valves shall be Victaulic Co. Series 751, or engineer approved equal by Viking.

C. Sprinkler Heads:

1. Sprinkler heads shall be new, UL listed and FM approved type of intermediate temperature rating, except where excessive temperatures are anticipated. In such areas, appropriate higher temperature ratings shall be used in accordance with NFPA Standard No. 13. Heads installed where they might receive injury shall be protected with approved guards. Spacing of heads shall be for "light hazard" and "ordinary hazard" occupancy as required. Heads shall have 1/2 in. orifices. Pendent heads, where required, shall be listed by Underwriters' Laboratories, Inc. and approved by Factory Mutual Engineering Corporation as suitable for pendent use in the type of system in which installed.

   a. Wrenches shall be provided by the sprinkler manufacturer that directly engage the hex-shaped wrench boss integrally cast in the sprinkler body. Victaulic FireLock Series.

2. Exposed upright and pendent "wet pipe" sprinkler heads for "light hazard" shall be Reliable Automatic Sprinkler Co., Inc. Model F1FR, Viking model M or Victaulic V27 Series, quick response chrome plated.

3. For ACT ceiling installation as shown, Victaulic V38 Series, Reliable Automatic Sprinkler Co., Inc. Model F4FR Concealed Automatic Sprinkler, white cover plate, 165°F temperature rating, 1/2" orifice, K-factor = 5.62

4. For Gypsum Board ceiling installation as shown, Victaulic V38 Series, Reliable Automatic Sprinkler Co., Inc. Model F4FR Concealed Automatic Sprinkler, white cover plate, 165°F temperature rating, 1/2" orifice, K-factor = 5.62

5. Dry-type Horizontal Sidewall heads for "light hazard" serving the exterior canopies, Victaulic V36 Series, Reliable Automatic Sprinkler Co., Inc. Model F3QR, quick response, chrome sprinkler head & escutcheon, glass bulb with special fluid rated for temperature as indicated on the plans. Dry barrel lengths are custom ordered and are available from 2" to 48" in ¼" increments.

6. For storage mezzanine as shown, Victaulic V27 Series, Reliable Automatic Sprinkler Co., Inc. Model F1FR exposed upright sprinkler head, 175°F temperature rating, ¾" orifice, K- factor = 8.0

7. Provide sprinkler head guards as indicated on the drawings, Victaulic or Reliable Automatic Sprinkler Co., Inc. Model C-1 for use with pendent, upright, horizontal sidewall and vertical sidewall sprinkler heads. These are intended to be installed onto sprinkler heads and are constructed of heavy gauge wire welded to steel mounting plates and finished with zinc plating.

8. Sprinkler heads shall be FM approved and UL listed as manufactured by Victaulic Company, The Reliable Automatic Sprinkler Co., Inc., Viking Corporation, Central or engineer approved equal. In all finish rooms or public areas, sprinkler heads shall be quick response recessed type. Provide adjustable extended escutcheons where indicated on the Drawings and as required.

2.2 EQUIPMENT

A. Fire Department Pumper Connection:

1. Fire department pumper connections shall be provided in accordance with the requirements set forth in NFPA Standard No. 13 and shall include an automatic drip. Hose threads shall be National Standard Fire Hose Threads (ANSI B26), complete with standard cap with chains. The pumper connection shall have one (1) 4 in. hose inlet (Storz) and one (1) 4 in. outlet (NPT), equipped with clappers. Fire department hose threads shall meet Montague Fire Department standards. The Fire Department connection shall be as manufactured by Potter-Roemer, Firematic Sprinkler Devices, Inc. Reliable Automatic Sprinkler Co. Inc., or

approved equal.

2. Fire department pumper connections shall be wall-mounted Storz fire department connection with polished brass body, one-way with brass plug with chain, Potter-Roemer Model 5795-01, UL Listed, all with polished brass finish and lettering on escutcheon reading “AUTOMATIC SPRINKLER.”

3. Furnish and install 4 in. check valve with automatic ball drip, Potter-Roemer Model 5982 (or series 4500), or approved equal.

4. At the low-point near each fire department connection, install a 90-degree elbow with drain connection to allow for system drainage to prevent freezing. Elbow shall be Victaulic #10-DR.

B. Sprinkler Cabinets: Sprinkler cabinets with a total of 12 sprinklers for each type of ratings installed and a sprinkler wrench shall be provided for each system and shall be installed at the main riser for each sprinkler system. Victaulic Company ‘SA’ Series.

C. Pipe Supports:

1. Metal pipe supports, hangers, clamps, etc., and all other accessories shall be of an UL listed and FM approved pattern and so placed as to conform with the requirements of NFPA Standard No. 13. Spacing of hangers shall not exceed that recommended in ANSI B31.1. All Victaulic piping shall be supported with two (2) hangers per length of pipe.

2. All piping installed under this Section of the Specifications shall be independently supported from the building structure and not from the piping, ductwork, or conduit of other trades. All supplementary steel required to meet the requirements specified herein shall be furnished and installed by the Fire Protection Subcontractor and shall be subject to the approval of the Architect-Engineer.

D. Wall, Floor, and Ceiling Plates: Piping passing through floors, walls, and ceilings shall be provided with metal sleeves and chromium plated steel or nickel-plated cast- iron plates. The spaces between piping and sleeves shall be filled with a noncombustible material.

E. Flow Switches:

1. Vane type waterflow switch with retard device, single pole double throw, "U" clamp, Gamewell Co. Series 9304 or equal by Potter Co., Notifier Co., or Gamewell, all at least Class 5 closed circuit.

2. All flow switches shall be equipped with a retard device, adjustable up to one (1) minute.

F. Valves Switches:

1. All sprinkler main valves and riser valves shall be furnished with supervision switches of the Universal Type OSYS-U as manufactured by Gamewell, Potter, Notifier Co., or approved equal.

2. This Subcontractor shall furnish and install a tamper switch on the post indicator valve. Wiring shall be by the Electrical Subcontractor.

G. Backflow Preventers:

1. Main Service Backflow Preventer: Ames model 2000ss or Ames “Colt” model #200 or Watts model #709OSY double check valve/backflow preventer. Device shall be U.L. listed and FM approved complete with (2) two OS&Y shut-off valves and detector meter. Provide one (1) complete rebuilding kit and deliver to Owner.

2. The Fire Protection Subcontractor shall be responsible for all permits, fees, and testing associated with the backflow preventer. Provide one (1) extra set of repair and rubber parts kits and one (1) Model TK-7-BFP test kit. All tests shall be certified by the Montague Water Department.

3. Equal Backflow Preventer manufacturers are Ames, Watts Regulator, Febco, Wilkins or Conbraco.

H. Alarm Test Modules: Furnish and install Victaulic Style 720 TestMaster II, AGF Manufacturing, Inc.'s UL listed and FM approved "Test and Drain" for the alarm test loops, where indicated on the Drawings, complete with combination sight glass/orifice. Pipe discharge to outdoors, or building drain.

I. Valves with Built-In Tamper Switches:

1. Furnish and install, at each Flow Control Station, Milwaukee Valve Co.'s Model BBVSCS02 grooved ends, 175 PSI, slow-closing "Butterball" butterfly valves, complete with built-in tamper switch for 2-1/2 in. pipe size; Model BB-SCS02 or Victaulic Series 728 for threaded pipe 2 in. and smaller.

2. Valves shall be Factory Mutual System approved and UL listed.

J. Waterflow Indicators: Waterflow indicators shall be the pressure or paddle type and shall be equipped with a self-winding, adjustable, recycling, non-thermal type signal- retarding device to prevent false alarms due to surges in the water system.

The riser assembly shall include a pressure gauge, a main drain assembly, and any other equipment necessary to provide a complete installation, connected as indicated.

K. Alarm Facilities: Equipment necessary to accomplish a local waterflow alarm signal for each system, one (1) transmitted coded waterflow signal for each group of system(s) and a local trouble alarm for each supervisory system shall be installed in each sprinkler system.

1. Local Waterflow Alarm Facilities: Facilities shall consist of an outside water motor gong and an electric bell furnished and installed by this Subcontractor, mounted where indicated. Electric power supply required for local alarms shall be taken from the house-current supply line on the line side of the main switch through an independent switch and fuse block or circuit breaker.

2. Alarm signals shall be transmitted over the fire alarm transmission system.

3. Grouped Automatic Control Valves: Where two (2) or more alarm check valves, waterflow indicators, or any combination of these facilities are supplied through one (1) common underground branch connection, one (1) local waterflow signal and one (1) local low-air pressure signal shall be provided for each group.

4. Electric Alarm Bell: System Sensor model SSM24-10 or SSV120-10 alarm bell. Coordinate with electrical/ fire alarm contractor for voltage and type of bell before ordering. Provide #WBB weatherproof backbox coordinating installation with others.

L. Valve Tags and Markings:

1. Furnish and install brass tags with S-hooks stamped with letters and numbers attached to the stem of each valve throughout all the systems.

2. Furnish complete chart and flow diagram of entire system listing the valve number, fluid controlled, and zone reference location for all valves corresponding to the tag numbers. The chart shall be framed under glass and hung in the Sprinkler Room where directed. Furnish two (2) extra copies of the chart to the Architect-Engineer.

3. Furnish and install a laminated red phenolic plate with engraved white lettering for each zone control flow switch and valve. Nameplates shall be located adjacent to all exposed and concealed valves.

M. Inspector's Test and Drain Connections:

1. Wet system test pipe shall not be less than 1 in. in diameter terminating in a smooth bore corrosion-resisting orifice giving a flow equivalent to one (1) sprinkler. A test pipe shall be provided for each system. Each test connection valve shall be readily accessible and labeled. The discharge shall be to the outside, to an open drain connection capable of accepting full flow under system pressure, or to another location where water damage will not result.

2. Drain connections shall be provided when a change in piping direction prevents drainage of sections of branch lines or mains through the main drain valve. The drain shall consist of a valve not smaller than 3/4 in. size and plug, at least one of which shall be brass.

N. Identification of Piping Systems:

1. Furnish and install OSHA approved identification valve tags, labels and flow direction arrows for all piping and equipment included in this Section. Labels shall be as manufactured by Seton Name Plate Company, or W.H. Brady Company, or approved equal.

2. All pipes shall be color coded and marked to identify the fluid. Color-coding shall conform to ANSI Bulletin A13.1 and OSHA 1910.262 for colors, location and sizes of bands and letters. Color-coded tags can be used when pipes are too small for labeling.

3. Markers shall be semi-rigid plastic equal to Set Mark Type "SNA" by Seton, or approved equal. Markings shall be placed where pipes pass through walls, or partitions, at all valves, where flow changes direction, and at junctions of pipes. On long runs of pipes, markers shall be placed every 20 feet, or where necessary to avoid confusion as to identification of pipes.

4. Install color-coded adhesive dots on ceiling grids for locating shut-off valves above hung ceilings.

PART 3 - EXECUTION

3.1 EXAMINATION & PHASING

A. Examine walls for suitable conditions where cabinets are to be installed, where required.

B. Do not proceed until unsatisfactory conditions have been corrected.

C. Coordinate installation with work of other trades especially the HVAC contractor. Piping shall be coordinated with ductwork installation to maximize headroom in all areas.

3.2 PIPE APPLICATIONS

A. Install Schedule 40 steel pipe with threaded joints and fittings for 2 inch and smaller and with welded or mechanical joints for 2 1/2 inch or larger. See materials for exceptions to schedule weight.

1. For pipe sizes 2 inch and smaller, Schedule 5 steel with Victaulic Pressfit® fittings and couplings may be used.

B. Install black steel for sprinkler piping. Install galvanized steel piping as required by NFPA and for all piping downstream of inspector's test valve.

C. Use approved fittings to make all changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

D. Install unions in pipes 2 inches and smaller, adjacent to each valve. Unions are not required on flanged devices or in piping installations using grooved mechanical couplings.

E. Install flanges or flange adapters on valves, apparatus, and equipment having 2-1/2 inch and larger connections. Install flange connection at all floor mains off of sprinkler risers.

F. Hangers and supports: Comply with the requirements of NFPA 13. Hanger and support spacing and locations for piping joined with grooved mechanical coupling Manufacturer's written instructions for rigid systems. Provide seismic bracing and protection from damage from earthquakes in accordance with NFPA 13 and state codes.

G. Make connections between underground and aboveground piping using an approved transition piece strapped or fastened to prevent separation.

H. Install test connections sized and located in accordance with NFPA 13 complete with shutoff valve. Test connections may also serve as drain pipes.

I. Install pressure gage on the riser or feed main at or near each test connection. Provide gage with a connection not less than 1/4 inch and having a soft metal-seated globe valve, arranged for draining piping between gage and valve. Install gages to permit removal and where they will not be subject to freezing.

J. Install flow switches and tamper switches where shown on drawings and as required for wiring to control panel by Division 16.

K. All piping and equipment running within trusses must be supported from top chord of truss at panel point. For any alternate configurations or for heavy pieces of equipment coordinate fully with structural engineer for support location before installation.

3.3 PIPE JOINT CONSTRUCTION

A. Weld Joints: AWS D10.9, Level AR-3.

B. Threaded Joints: conform to ANSI B1.20.1, Tapered pipe threads for field cut threads. Join piping, fittings, and valves as follows:

a. Note the internal length of threads in fittings or valve ends, and proximity of internal seat or wall, to determine how far pipe should be threaded into joint.
b. Align threads at point of assembly.
c. Apply appropriate tape or thread compound to the external pipe threads.
d. Assemble joint to appropriate thread depth. When using a wrench on valves, place the wrench on the valve end into which the pipe is being threaded.
e. Damaged Threads: Do not use pipe with threads that are corroded or damaged. If a weld opens during cutting or threading operations, that portion of pipe shall not be used.

C. Flanged Joints: Align flanges surface parallel. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly to appropriate torque specified by the bolt manufacturer.

D. Mechanical Grooved Joints: Cut or roll grooves on pipe ends dimensionally compatible with the couplings.

a. Cut or roll grooves on pipe ends dimensionally compatible with the couplings.

b. Pipe ends shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove.
c. Gasket should be lubricated with lubricant supplied by the manufacturer or approved for use with the gasket by the manufacturer.
d. The grooved coupling manufacturer's factory trained representative shall provide on-site training for contractor's field personnel in the use of grooving tools and installation of grooved joint products. The representative shall periodically visit the jobsite and review contractor is following best recommended practices in grooved product installation. (A distributor's representative is not considered qualified to conduct the training or jobsite visit(s).)

E. End Treatment: After cutting pipe lengths, remove burrs and fins from pipe ends.

3.4 VALVE INSTALLATIONS

A. General: Install fire protection specialty valves, fittings, and specialties in accordance with the Manufacturer's written instructions, NFPA 13 and 14, and the authority having jurisdiction.

B. Gate Valves: Install supervised open gate valves so located to control all sources of water supply except fire department connections. Where there is more than one control valve, provide permanently marked identification signs indicating the portion of the system controlled by each valve.

C. Install backflow preventers in each water supply connection.

3.5 SPRINKLER HEAD INSTALLATIONS

A. Use proper tools to prevent damage during installations.

B. Install sprinkler heads in the center of acoustical ceiling tiles. Where installed under sloped ceilings or roofs, install heads so deflectors are parallel with slope.

C. Install heads so that roof trusses, joists and mechanical equipment does not interfere with proper coverage.

D. Provide additional heads under mechanical ductwork and equipment exceeding 4' in width and as required to maintain complete coverage.

E. Do not install sprinklers that have been dropped, damaged, or show a visible loss of fluid. Never install sprinklers with cracked bulbs.

F. Sprinkler bulb protector shall be removed by hand after installation. Do not use tools or any other device(s) to remove the protector that could damage the bulb in any way.

3.6 WATER FLOW SWITCHES

A. All flow switches shall be located in a manner to allow proper access for service and repair. All switches shall be set with the control box on the top of the pipe. Devices may be mounted on a horizontal or vertical pipe. On horizontal pipe, they should be installed on the topside of the pipe where they will be accessible. The units should not be installed within 6 inches of a fitting, which changes the direction of waterflow, or within 24 inches of a valve drain.

3.7 SUPERVISORY SWITCHES

A. All supervisory switches shall be located in a manner to allow proper access for service and repair.

3.8 FIRE DEPARTMENT CONNECTION

A. Fire Department connection shall be set no less than 1’-6” or more than 3’-6” above outside grade.

3.9 ACCESS PANELS

A. Furnish and deliver access panels for access to all concealed parts of the Fire Protection System that require accessibility for the proper operation and maintenance of the system. The appropriate trades shall install access panels.

3.10 TESTING

A. The Fire Protection Subcontractor shall coordinate and perform all tests as required by NFPA 13 and NFPA 25, Insuring Agency, and the Montague Fire Department at no expense to the Owner.

B. The scope of work consists of the furnishing of all labor, materials, tools, equipment, supervision, services, and incidentals necessary for the installation of an automatic sprinkler system installed complete and ready for standard operation. System shall be installed in all spaces indicated on the Drawings. The system shall include sprinkler risers connected to the water system, alarm check valve and appurtenances, circuit opener and closer, water motor alarm gong, zone valves, fire department pump

connection, check valves, sprinkler heads and piping, and such other standard accessories as are necessary for a complete, approved system. The Fire Protection Subcontractor shall obtain all necessary permits, file all necessary Drawings, obtain all approvals, and pay all fees required to complete the work of this Section.

C. After the installation has passed a satisfactory hydrostatic test, all iron and steel parts shall be thoroughly cleaned. All piping and other items, except sprinkler heads, bronze or brass fittings, other corrosion resistant materials and moving parts, shall be given a priming coat of good quality, red lead type paint and a finish coat of paint, the color of which is to be determined by the Architect-Engineer.

END OF SECTION 21 00 01

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SECTION 22 00 00
Plumbing

(Filed Sub-Bid)

1.1 DESCRIPTION

A All of the Contract Documents, including General and Supplementary conditions and Division 0 – Bidding Documents, Contract Forms and Conditions of the Contract and Division 1 – General Requirements, apply to the work in this Section.

B Carefully examine all the Contract Documents for requirements which affect the work of this Section. The exact scope of this Section cannot be determined without a thorough review of all specifications sections and other Contract Documents.

C Where referred to, Standard Specifications, Recommendations of Technical Societies, and/or Manufacturer's Associations, plus Codes of Federal, State, and Local Agencies shall include all amendments current as of date of issue of these specifications.

1.2 REQUIREMENTS FOR SUBMITTING FILED SUB-BID

A. Sub-bids shall be submitted for the Work of this Section in accordance with the provisions of M.G.L. c.149 §§44A-J The time and place for submission of sub-bids are set forth in the **Advertisement.** The procedures and requirements for submitting sub-bids are set forth in the **Instructions to Bidders.**

B. Sub-bidders must be DCAMM Certified in the listed trade and shall include a Current DCAMM sub-bidder Certificate of Eligibility and a signed DCAMM Sub-bidder’s Update Statement with the bid

C. Specification requirements for the Filed Sub-bid "Plumbing" include all of the following listed Specification Sections in their entirety.

SECTION 01 91 13 - GENERAL COMMISSIONING
SECTION 22 00 01 - PLUMBING
SECTION 22 08 00 - COMMISSIONING OF PLUMBING

D. The Work of this Section is shown on Drawings

TS-001, R-101, R-102, A-001, A-101, A-103, A-104, A-501, A-602, A-603, A-604, A-605, P-100, P-101, P-102, P-201

E. SUB-SUBS

1. Sub-sub bids are required for this Section. Sub-Bidders shall include the appropriate information for the list of sub sub-bid Class of Work noted below in this paragraph. NOT APPLICABLE

2. If the Filed Sub-Bidder customarily performs the above Work with its own workforce, the Sub-Bidder should list its own name and trade and leave the dollar amount blank.

3. If the Filed Sub-Bidder does not customarily perform the Classes of Work with its own workforce, the Sub-Bidder should list the name of the contractor performing the work, the trade and insert a dollar amount.

END OF SECTION

SECTION 22 00 01

PLUMBING
(Filed Sub-Bid Required)

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Attention is directed to the general and supplementary conditions and Division 1 including all sub-divisions thereof as listed in the table of contents, which are hereby made a part of this Section.

B. All work shall comply with all federal, state and local codes and any other authorities having jurisdiction.

1.02 SUMMARY OF WORK

A. Perform work and provide material and equipment as required for a complete and operational plumbing system as shown on the Drawings and as specified in this Section. Completely coordinate with work of other trades and provide for complete and fully functional installation.

B. The work shall include, but is not limited to, the following major items of work:

1. Provide a complete sanitary waste, vent and hot & cold water systems for the building. Installation shall be in accordance with the Commonwealth of Massachusetts Plumbing Code and all other applicable codes and authorities having jurisdiction.

2. Provide garage waste and vent piping to the gas/sand trap outside. Provide floor and trench drains and all interconnecting piping. Provide gas/sand trap outside.

3. Provide all plumbing fixtures, floor drains and equipment as required and indicated on the drawings and as specified herein. This shall include all necessary waste, vent, cold water & hot water services.

4. Provide indirect-fired water heater, recirculation pumps, thermostatic mixing valves and expansion tank. Provide all associated piping for domestic hot water system.

5. Provide compressed air system for the Vehicle Repair Garage which includes air compressor mounted on air receiver, refrigerated air dryer and piping to the building.

6. Obtain all permits and approvals required for work under this Section. This section shall pay all permit fees required by the local Water Department.

C. ALTERNATES:

Special attention is called to the fact that it shall be the responsibility of all the General and Subcontractors to thoroughly examine all the alternates and evaluate for themselves as to whether or not these alternates in any way affect their respective sections. In the event that a contractor feels that any alternate(s) do reflect a cost difference, additional or a deduction, in his bid proposal, then he shall stipulate his sum and/or sums under the proper alternate(s) as provided for in the bid proposals. Failure to do so will in no way relieve the herein before stated contractors of their responsibilities regardless of what alternate(s) are selected and no extra cost will be charged to the Owner. Refer to SECTION - ALTERNATES, for list and description of Alternates.

D. This contractor is responsible for sleeving all holes required of his work prior to pouring of the concrete slabs. All holes less than or equal to 1-1/2" shall be the responsibility of this contractor to core. Sizes larger shall be cored by the G.C. However, if coring is required due to the failure of this contractor to set a sleeve prior to pouring than this contractor shall be responsible for bearing the cost of any of this additional coring work required of the G.C.

E. Where the specifications and/or plans conflict, the more stringent (costly) requirement shall control. Clarification from Engineer shall be obtained before proceeding.

1.03 COORDINATION

A. Before starting work, visit site and examine conditions under which work shall be performed including preparatory work by others. Report conditions which might adversely affect the work in writing to the Architect. Do not proceed with the work until the defects have been corrected and conditions are satisfactory. Commencement of work shall be construed as acceptance of preparatory work and existing conditions.

B. Completely coordinate with work of other trades and provide for complete and fully functional installation. Although not specifically shown, provide supplementary or miscellaneous items, devices, appurtenances and materials incidental to or necessary for sound, secure and complete installation.

C. This contractor is responsible for coring and sleeving all holes required of the respective work. All penetrations shall be sealed. All penetrations of fire rated walls, floors and ceilings shall be firestopped.

1.04 RELATED WORK

A. Carefully examine all of the Contract Documents for requirements which affect work of this Section.

B. Other specification sections which directly relate to the work of this Section include, but are not limited to, the following:

- Section 21 00 00 – Fire Protection
- Section 23 00 00 – HVAC
- Section 26 00 00 - Electrical

C. The following related work will be performed by other Divisions of the specifications:

1. Concrete work, including housekeeping pads.
2. Cutting and patching of masonry, concrete, tile and other parts of structure, with the exception of drilling for hangers and coring as defined herein. Any piping penetrations not sleeved by this division at time of floor slab pouring or wall construction shall be core drilled by this division. Coordinate with Architect.
3. Installation of access panels in ceilings and walls. Access panels shall be furnished by this Section.
4. Painting, except as specified herein.
5. Electric power wiring for all equipment. Control wiring shall be performed by this Section.
6. Structural supports except as specified herein.
7. Temporary light, power, water, heat, gas and sanitary facilities for use during construction and testing.

1.05 CODES, STANDARDS AND AUTHORITIES

A. Perform all work in strict accordance with all rules, regulations, standards, codes, ordinances and laws of local, state and Federal governments, and other authorities having lawful jurisdiction, and be responsible for compliance therewith. Such authorities include but are not limited to the following: NFPA, OSHA, AGA, & EPA.

B. Give notices, file plans, obtain licenses and permits, pay fees and backcharges and obtain necessary approvals from authorities having jurisdiction.

C. Material and equipment shall be Underwriters' Laboratories (UL) listed for the service for which it is being used.

D. Whenever two or more codes, regulations, etc., conflict with each other or with the Contract Documents, the more severe requirements shall govern the conduct of the work.

1.06 GUARANTEE

A. Guarantee work performed under this Section in accordance with Division 1, General Requirements. Operation of systems or equipment for temporary services does not constitute beginning of guarantee period.

B. The Contractor also agrees to furnish service of the equipment for the above period, such service to be rendered quickly and promptly at the request of the Owner. This shall not be misconstrued to include routine maintenance.

1.07 CONTRACT DOCUMENTS

A. Plumbing drawings do not limit responsibility of determining full extent of work required by Contract Documents. Locations shown on drawings shall be checked against construction proper.

B. Drawings are diagrammatic and indicate general arrangement of systems and work of this Contract.

1.08 DISCREPANCIES IN DOCUMENTS

A. Where Drawings or Specifications indicate discrepancies or are unclear, advise Architect in writing before award of Contract. Otherwise, Architect's interpretation of documents shall be final and no additional compensation shall be permitted due to discrepancies or unclear items.

B. Where Drawings or Specifications do not coincide with recommendations of the manufacturer of a material or piece of equipment, this shall be brought to the attention of the Architect in writing before installation of item in question. Otherwise, make changes in installation as Architect requires without additional cost to the Owner.

1.09 RECORD DRAWINGS

A. Maintain record drawings during construction in accordance with the General Conditions of the Contract.

1.10 SUBMITTALS

A. Submit in accordance with Section 01 30 00, SUBMITTALS.

B. Submit shop drawing or product data for the following:
1. Plumbing fixtures, flush valves, faucets and accessories.
2. Piping, valves, expansion tank and accessories.
3. Floor Drains and Trench Drains.
4. Indirect-Fired Water Heater.
5. Recirculation Pumps.
6. Thermostatic Mixing Valves.
7. Potable water rated expansion tank.
8. Pipe insulation.
9. Pressure gauges and thermometers.
10. Trap primer valves and piping for floor drains.
11. Piping for Gas Sand Trap
12. Hose Bibs and Sillcocks.
13. Water Meter – Coordinate with Montague DPW (i.e. owner)
14. Air Compressor.
15. Refrigerated Air Dryer.

1.11 OPERATING AND MAINTENANCE INSTRUCTIONS

A. Prior to the final inspection, the Plumbing Contractor shall provide to the Architect three (3) sets of operating and maintenance instructions. The Architect shall review the instructions for completeness prior to turning them over to the Owner.

B. Instructions: The Contractor shall provide qualified, factory-trained manufacturers' representative to give detailed instruction to assigned Owner personnel in the operation and complete maintenance for all equipment. All such training will be at the job site.

PART 2 - PRODUCTS

2.01 PRODUCTS CRITERIA

A. Standard Products: Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products for at least 3 years. See other specification sections for any exceptions.

B. Multiple Units: When two or more units of materials or equipment of the same type or class are required, these units shall be products of one manufacturer.

C. Nameplates: Nameplate bearing manufacturer's name or identifiable trademark shall be securely affixed in a conspicuous place on equipment, or name or trademark cast integrally with equipment, stamped or otherwise permanently marked on each item of equipment.

D. Asbestos products or equipment or materials containing asbestos shall not be used.

E. Lead free products shall be used for all piping, fittings, valves, faucets and any other component that comes in contact with potable water.

2.02 PLUMBING FIXTURES

A. Provide plumbing fixtures as specified herein. Fixture trim, traps, faucet, escutcheons and waste pipes exposed to view in finished spaces shall be I.P.S. brass with polished chromium plating over nickel finish. Fixtures shall have manufacturer's label or trademark indication first quality.

B. Fixtures with wall outlet flanges shall be set proper distance from floor or wall to make first-class joint with closet setting compound or gasket.

C. Mounting heights shall be as shown on architectural details.

D. Each individual fixture shall be provided with supply stops for each water service.

E. Exposed piping below handicap lavatories and sinks shall be insulated with PVC coated insulation similar to Truebro LavGuard 2 or Handy-Shield by Plumberex. The product shall be rigid high-impact, stain-resistant PVC, 1/8” constant wall thickness with internal ribs, have UV protection, and have an E-Z Tear-To-Fit trim feature. The color shall be china white and shall be Compatibility #100 series to fit all 1-1/4” or 1-1/2” cast brass or tubular P-trap assemblies and 3/8” or ½” angle stop assemblies.

F. Fixture Schedule: Unless otherwise specified, fixtures shall be as follows (Note: Model numbers are provided to set standard of fixture) :

1. China Fixtures including Water Closets, Urinals and Lavatories: Toto USA, American-Standard, Kohler Company, Zurn ZPPG, Eljer Plumbingware Inc., Crane Plumbing.

2. Manual Flush Valves: Toto USA, Sloan Valve Company, Zurn ZPPG, Delta Faucet Company.
3. Lavatory Metering Faucets: Toto USA, Symmons Industries Inc., Powers (a Watts Industries Co.), American Standard, Zurn ZPPG, Chicago Faucets, Delta Faucet Company.
4. Shower Valves: Symmons Industries Inc., Zurn ZPPG, Powers (a Watts Industries Co.), Leonard Valve Co.
5. Countertop Sink: Elkay Sales Inc., Just Manufacturing Co., Kohler Company.
6. Countertop Sink Faucet: Symmons Industries Inc., American Standard, Zurn ZPPG, Chicago Faucets, Moen Incorporated, Delta Faucet Company.
7. Water Cooler: Elkay Sales Inc., Halsey Taylor, Oasis Corporation, Haws Corporation.
8. Mop Sink/Utility Sinks: Stern-Williams, Crane Plumbing/Fiat Products, Zurn ZPPG, E.L. Mustee & Sons, Florestone Products Co.
9. Mop Sink/Utility Sink Faucets: Crane Plumbing/Fiat Products, Stern-Williams, American Standard, Chicago Faucets, Speakman Co.
10. Emergency Shower/Eyewash: Guardian Equipment, Bradley, Haws, Chicago Faucets.

P-1 Wall Hung Water Closet: American Standard model #3351.101 “Afwall Millenium FloWise” Toilet, wall-mount, elongated, flushometer valve toilet, vitreous china, high efficiency @ 1.28 gallons per flush (GPF), condensation channel, direct-fed siphon jet, 1-1/2” inlet spud, fully glazed 2-/8” trapway, 10”x12” water surface area, 100% factory flush tested.
Sloan Royal model #111-1.28; exposed water closet flushometer for floor mounted or wall hung top spud bowls. Flushometer shall be quiet, exposed, diaphragm type, chrome plated for left or right hand supply, water closet type with the following features:

- PERMEX™ synthetic rubber diaphragm with dual filtered fixed bypass.
- ADA compliant metal oscillating non-hold-open handle with triple seal handle packing.
- 1” I.P.S. screwdriver Bak-Chek® angle stop with free spinning vandal resistant stop cap.
- Adjustable tailpiece.
- High back pressure vacuum breaker flush connection with one-piece bottom hex coupling nut
- Spud coupling and flange for 1-1/2” top spud.
- Sweat solder adapter with cover tube and cast wall flange with set screw.
- High copper, low zinc brass castings for dezincification resistance.
- Non-Hold-Open handle, fixed metering bypass and no external volume adjustment to ensure water conservation.
- Flush accuracy monitored by CID™ Technology.
- Diaphragm, stop seat and vacuum breaker molded from PERMEX™ rubber compound for chloramines resistance.

Bemis #495SSC extra heavy weight, thermoset fireproof material, elongated, open front seat, less cover with integral molded-in bumpers, self-sustaining and external check hinge feature 300 series stainless steel posts that hold seat in any raised position up to 11 degrees beyond vertical, color white. Similar toilet seats are Church #9500SSCT or Kohler #K-4731.
Zurn Industries, Jay R. Smith or Josam hub and spigot combined waste fitting and chair carrier supports, with adjustable extensions, rear foot support and face plate with foot support & feet bolted to floor, with seat mounting height to be 15" above finished floor.

P-2 Wall Hung Water Closet (Handicap): Same as P-1 except mounted 18" floor to rim. Modify flush valve to allow clearance for grab bar installation.

P-3 Floor Mounted Water Closet: American Standard model #2234.001 "Madera FloWise" 15"H Toilet, floor-mount, elongated, flushometer valve toilet, vitreous china, high efficiency @ 1.28 gallons per flush (GPF), 10" or 12" rough-in, 15" rim height, condensation channel, direct-fed siphon jet, 1-1/2" inlet spud, fully glazed 2-1/8" trapway, 10"x12" water surface area, 100% factory flush tested.
Sloan Royal model #111-1.28; exposed water closet flushometer for floor mounted or wall hung top spud bowls. Flushometer shall be quiet, exposed, diaphragm type, chrome plated for left or right hand supply, water closet type with the following features:

- PERMEX™ synthetic rubber diaphragm with dual filtered fixed bypass.
- ADA compliant metal oscillating non-hold-open handle with triple seal handle packing.
- 1" I.P.S. screwdriver Bak-Chek® angle stop with free spinning vandal resistant stop cap.
- Adjustable tailpiece.
- High back pressure vacuum breaker flush connection with one-piece bottom hex coupling nut
- Spud coupling and flange for 1-1/2" top spud.
- Sweat solder adapter with cover tube and cast wall flange with set screw.
- High copper, low zinc brass castings for dezincification resistance.
- Non-Hold-Open handle, fixed metering bypass and no external volume adjustment to ensure water conservation.
- Flush accuracy monitored by CID™ Technology.
- Diaphragm, stop seat and vacuum breaker molded from PERMEX™ rubber compound for chloramines resistance.

Bemis #495SSC extra heavy weight, thermoset fireproof material, elongated, open front seat, less cover with integral molded-in bumpers, self-sustaining and external check hinge feature 300 series stainless steel posts that hold seat in any raised position up to 11 degrees beyond vertical, color white. Similar toilet seats are Church #9500SSCT or Kohler #K-4731.

P-4 Floor Mounted Water Closet (Handicap): American Standard model #3461.001 “Madera FloWise” Toilet, floor-mount, elongated, flushometer valve toilet, vitreous china, high efficiency @ 1.28 gallons per flush (GPF), 10” or 12” rough-in, 16-1/2” rim height, condensation channel, direct-fed siphon jet, 1-1/2” inlet spud, fully glazed 2-1/8” trapway, 10”x12” water surface area, 100% factory flush tested.
Sloan Royal model #111-1.28; exposed water closet flushometer for floor mounted or wall hung top spud bowls. Flushometer shall be quiet, exposed, diaphragm type, chrome plated for left or right hand supply, water closet type with the following features:

- PERMEX™ synthetic rubber diaphragm with dual filtered fixed bypass.
- ADA compliant metal oscillating non-hold-open handle with triple seal handle packing.
- 1” I.P.S. screwdriver Bak-Chek® angle stop with free spinning vandal resistant stop cap.
- Adjustable tailpiece.
- High back pressure vacuum breaker flush connection with one-piece bottom hex coupling nut
- Spud coupling and flange for 1-1/2” top spud.
- Sweat solder adapter with cover tube and cast wall flange with set screw.
- High copper, low zinc brass castings for dezincification resistance.
- Non-Hold-Open handle, fixed metering bypass and no external volume adjustment to ensure water conservation.
- Flush accuracy monitored by CID™ Technology.
- Diaphragm, stop seat and vacuum breaker molded from PERMEX™ rubber compound for chloramines resistance.

Bemis #495SSC extra heavy weight, thermoset fireproof material, elongated, open front seat, less cover with integral molded-in bumpers, self-sustaining and external check hinge feature 300 series stainless steel posts that hold seat in any raised position up to 11 degrees beyond vertical, color white. Similar toilet seats are Church #9500SSCT or Kohler #K-4731.

P-5 Wall Hung Urinal: American Standard #6590.001 “Washbrook FloWise 0.5 GPF High Efficient Urinal, vitreous china, low consumption 0.5 GPF, flushing rim, elongated 14” rim from finished wall, washout flush action, extended sides for privacy, ¾” inlet spud, outlet connection threaded 2” inside (NPTF), strainer included, ,meets ANSI flush requirements for 0.5 GPF.
Sloan Royal model #186-0.5; exposed high efficiency manual urinal flushometer for top spud high efficiency urinals. Flushometer shall be quiet, exposed, diaphragm type, chrome plated, urinal type with the following features:

- Dual linear filtered bypass diaphragm .
- ADA Compliant metal oscillating Non-Hold-Open handle with triple seal handle packing

- 3/4" I.P.S. screwdriver Bak-Chek® angle stop with free spinning vandal resistant stop cap.
- Adjustable tailpiece.
- High back pressure vacuum breaker flush connection with one-piece bottom hex coupling nut
- Spud coupling and flange for 3/4" top spud.
- Sweat solder adapter with cover tube and cast wall flange with set screw.
- High copper, low zinc brass castings for dezincification resistance.
- Non-Hold-Open handle, fixed metering bypass and no external volume adjustment to ensure water conservation.
- Flush accuracy monitored by CID™ Technology.
- Diaphragm, handle packing, stop seat and vacuum breaker molded from PERMEX™ rubber compound for chloramines resistance.

Provide Zurn #Z1222 concealed carrier, Jay R. Smith, or Josam urinal carrier, with bearing and hanger plates,(vandalproof trim) or provide carrier as required to suit construction, with feet bolted to floor. Install with rim at 24" above finished floor.

P-6 Wall Hung Urinal (Handicap): Same as P-5 except mounted 17" floor to rim.

P-7 Wall Hung Lavatory: American Standard #0954.004 "Murro Universal Design" Commercial Wall-Hung Lavatory, 20.5" deep x 21-1/4" wide, vitreous china, wall hung, 4" center faucet holes, recessed self-draining deck, rear overflow, punching for concealed arm carrier;
Symmons model #SLC-6000 "Scot" Metering Lavatory Faucet, 4" centerset mount, 3/8" copper supply tubes, temperature limit stop, adjustable flow time and 0.5 GPM vandal resistant aerator; total flow per cycle must not exceed 0.25 GPC fall all flow rate options; faucet constructed from brass, plated in standard polished chrome finish.
McGuire, Proflo or T&S Brass heavy duty polished chrome-plated cast brass angle valve kits, loose key, flexible risers, escutcheons. 1-1/4" x 1-1/2" polished chrome plated cast brass adjustable "P" trap, cleanout plug, extension to wall with escutcheon.
Concealed arm carrier support with foot support to suit construction. Install with rim at 30" maximum above finished floor.

P-8 Wall Hung Lavatory (Handicap): Same as P-7 except mounted 34" floor to rim. Insulate piping under lavatory as specified in section 2.02.E.

P-9 Shower Valve: Shower stall and accessories shall be furnished and installed by the G.C. Provide shower valve as follows:
Symmons Safetymix Shower System #1-100-X-1.5 to include:
Safetymix pressure-balancing mixing valve with lever style handle. Valve includes adjustable stop screw to limit handle turn; Super shower head #4-231

single mode with adjustable flood or mist spray; showerhead arm and flange; 1.5 GPM flow restrictor; integral stops; polished chrome finish.
Provide floor drain, FD-1 (specified in section 2.15.B) as drain in shower stall.

P-10 Shower Valve (Handicap)- Handicap shower stall and accessories shall be furnished and installed by the G.C. Provide shower valve as follows: Symmons Origins Shower/Hand Shower System #S-9605-PLR-X to include: Temptrol pressure-balancing valve with adjustable stop screw to limit handle turn, 36" slide bar, separate two function diverter, in-line vacuum breaker, 60" flexible metal hose, ADA hand shower, one (1) mode showerhead wih rubber nozzles and standard 2.5 GPM flow restrictors; components shall be made from metal and nonmetallic materials, plated in standard polished chrome finish; integral service stops.
Provide floor drain, FD-1 (specified in section 2.15.B) as drain in shower stall.

P-11 Single Compartment Countertop Sink (Handicap): Elkay model #GECR-2521 "Celebrity" 25"x21-1/4" nominal, 21"x15-3/4" bowl, 20-gauge type 304 stainless steel, self-rimming countertop sink; seamlessly drawn from nickel bearing stainless steel; bowl depth = 5-3/8"; 3" radius vertical coved corners; exposed surfaces machine polished to a highlighted bright finish; underside fully protected by a heavy duty Sound Guard undercoating; 3-1/2" centered drain opening; faucet holes on 8" centers; 4 faucet holes; Quick Connect. Symmons "Symmetrix" model #S-23-IPS-VP single lever handle kitchen faucet with ceramic control components and handle limit stop. 8 3/4" swing spout with aerator, 3/8" supplies, 8" centers, metal construction, polished chrome finish, faucet with 1/2" IPS adaptors and vandal resistant aerator. Elkay model #LK35B Standard Cup Strainer, fits 3-1/2" opening (4-1/2" top diameter), stainless steel conical strainer basket with flex stem and rubber stopper, C.P. brass, 1-1/2" O.D. tailpiece.
Provide McGuire or Chicago (#STC-11-11-AB) heavy duty, lead free, polished chrome-plated cast brass quarter-turn ball valve with convertible loose key handle, flexible risers, escutcheons. 1-1/2" x 1-1/2" polished chrome plated cast brass extension to wall with escutcheon (no p-trap required). Insulate piping under sink.

P-12 Janitor Sink: Fiat model #MSBID-2424 molded stone mop service basin with integral drain, 24"x24"x10"D, 1" wide shoulders; factory installed drain body shall be stainless steel and designed to provide for a lead caulk or QDC-3 joint to a 3" drain pipe; provide Chicago Faucets, Symmons or Fiat model #830-AA chrome plated faucet with brace and integral vacuum breaker, #832-AA heavy duty hose and hose bracket, and #889-CC mop hanger with three (3) tool hangers.

P-13 Washer Supply/Drain: Symmons model #W-602-X Laundry-Mate supply and drain unit with ½" supplies and 2" drain with integral stops and recessed wall box with wall plate.

P-14 Wall Mounted Water Cooler (Handicap): Elkay model #VRCGRN8 High Efficiency Wall Mount Water Cooler, Vandal Resistant, Barrier-Free Access shall have the following features:

GENERAL: GreenSpec® Listed, energy and water efficient model. Self-contained, wall hung electric, refrigerated water cooler. Vandal-resistant unit for use in high demand locations. Flow regulator provides constant stream from 20 to 105 psi water pressure. Rated for indoor and outdoor use.

Non-pressurized cooling tank is standard. Non-pressurized water tank is located after bubbler valve, so that tank is subject to line pressure only when push button is pressed.

ADA COMPLIANT: These Water Coolers comply with the requirements of A.D.A. (Americans with Disabilities Act) when properly installed. Also meets the guidelines for children's environments providing the floor to orifice height is 30" or less and proper clear floor space is provided for parallel approach. (Based on Architectural and Transportation Barriers Compliance Board final ruling.) Check Local and State Codes.

NO LEAD DESIGN: These Water Coolers are certified to be lead-free as defined by the Safe Drinking Water Act. Elkay Water Coolers are manufactured with a waterway system utilizing copper components and completely lead-free materials. These waterways have no lead because all lead materials, such as leaded brass, have been removed. All joints are brazed using silver solder only. No lead solder is permitted. A strainer with an easily cleanable screen is provided to allow trapping and convenient removal of waterborne particulate of 140 microns and larger prior to their entry into the water cooler.

ENERGY-EFFICIENT COOLING SYSTEM

Motor Compressor: High-efficiency, hermetically sealed, reciprocating type, 115 Volt/60 Hz, single phase. Sealed-in lifetime oil supply. Equipped with electric cord and three prong molded rubber plug.

Condenser: Fan cooled, copper tube with aluminum fins. Fan motor is permanently lubricated.

Cooling Unit: Combination tube-tank type. Designed for optimized heat transfer within the evaporator. Fully insulated.

Refrigerant Control: Refrigerant HFC-134a is controlled by accurately calibrated capillary tube for positively trouble-free operation.

Temperature Control: Enclosed adjustable thermostat is factory preset. Requires no adjustment other than for altitude requirements. Easily accessible.

CONSTRUCTION

Frame: Galvanized structural steel chassis supports fountain top and cabinet panels.

Fountain Top: Series 300 one piece stainless steel top, polished to a uniform Elkay bright luster finish. Basin has embossed bubbler pad.

Bubbler: Water-efficient, heavy-duty, vandal-resistant bub- bler in one-piece construction. Keyed into position to prevent rotation. Meets UL requirements and all sanitary codes.

Cabinet: Cabinet design allows for flush to wall mounting. No recess space is required. Includes bottom cover plate fastened with vandal-resistant screws.

Color Selection: Stainless steel furnished as standard.

P-15 1-Bay Utility Sink: Fiat model #FL-1 Floor Mounted Serv-A-Sink®, single compartment molded-stone floor mounted laundry tub with heavy gauge galvanized wall bracket; side fillers made of white molded plastic polymer; 23”x22” nominal size, 20 gallon capacity, mount @ 33-1/2” floor to rim. Fiat model #A-1 Deck Type Faucet on 4” centers with a 6-3/4” threaded spout. Fiat model #A-2 Overflow Pipe.

P-16 Emergency fixtures shall be as follows: Haws Corporation model #8300-8309 combination shower and eye/face wash shall include a stainless steel 11" (27.9 cm) round bowl, an AXION® MSR eye/face wash head shall feature inverted directional laminar flow which achieves zero vertical velocity supplied by an integral flow control. Unit shall also include the AXION MSR hydrodynamic designed ABS plastic showerhead with flow control, chrome-plated brass stay-open ball valve equipped with stainless steel ball and stem, and chrome-plated brass in-line 50 x 50 mesh water strainer. Unit shall also include Schedule 40 hot-dipped galvanized steel pipe and fittings, powder-coated cast-iron 9" (22.9 cm) diameter floor flange, self-adhesive high visibility safety green and bright yellow stripes, universal sign, and 1-1/4" IPS supply.

2.03 PIPE MATERIALS

A. Storm, sanitary, drainage, vent pipe and fittings above ground: 2-1/2 inches and larger - hubless cast iron, service weight soil pipe, mechanical joint. 2 inch and smaller - Type DWV, hard temper copper pipe with cast brass, 95/5 solder joints, solder joint drainage fittings. All garage waste and vent piping shall be cast iron. All cast iron soil pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute (CISPI) and be listed by NSF International.

1. Furnish and install hubless soil pipe couplings designated Heavy Weight (HW), made of extra wide, heavy duty corrugated type 304 stainless steel with axially slotted heavy duty, worm drive clamps tightened to 80 in lbs. of torque. Flanged gaskets to be made of neoprene rubber, meeting the requirements of ASTM C

564, with sealing rings under each stainless steel clamp. Manufacturers shall be Mission Heavy Weight, Husky 4000 or Clamp-All 125.

B. All hot water, cold water, tempered water and hot water recirculating piping within the building shall be hard copper Type "L" seamless drawn tubing assembled with sweat fittings. All solder used shall be lead free, cadmium free, "Silverbrite - 100", Kester or Worthington, complying with the latest issue of ANSI A-5.8 publication. All exposed runs to all toilet fixtures and sinks shall be chrome plated.

1. Mechanical grooved pipe couplings, fittings, Mechanical T's, and other products are acceptable to be used on piping systems and mechanical equipment connections 2"diameter and larger (in lieu of welded/flanged and threaded methods) in systems specified. Operating conditions not to exceed -30°F to 250°F temperature range according to the gasket lining selected and working pressures as shown in the coupling manufacturer's current product specifications.
   a) Copper Piping Systems: Grooved piping products for use with ASTM B88 hard Type L copper tubing shall be copper tubing sized. (Flaring of pipe ends to IPS dimensions is not allowed.) Fittings shall be ASTM B75 or B152 wrought copper or ASTM B584-87 bronze sand casting. Couplings shall be ASTM A395 and A536 ductile iron, with angle pattern bolt pads for rigidity upon visual confirmation of metal-to-metal bolt pad contact with no torque requirement. Coupling housings coated with copper colored alkyd enamel. Gaskets shall be Style "EHP" EPDM grade to suit the intended service. Gaskets used on potable water systems shall be EPDM, UL classified in accordance with ANSI / NSF61 for both hot (180F) and cold (86F) potable water service.

2. Press Fitting: Copper press fittings shall conform to the material and sizing requirements of ASME B16.18 or ASME B16.22. O-Rings for copper press fittings shall be EPDM.
   a. Manufacturers of Copper Press Fittings:
      Viega, 17545 Daleview Dr., Lakewood, OH 44107, (877) 620-0016;
      Rigid Tool Company, 400 Clark Street, Elyria, OH 44035, (800) 519-3456;
      Elkhart Products Corporation "Xpress Press-Connect Fittings", 1255 Oak Street, Elkhart, Indiana 46515, (800) 284-4851
      Nibco Press System, 1516 Middlebury Street, Elkhart, IN 46516-4740, (800)234-0227

3. Vic-Press 304™ Fittings: In lieu of alternate piping methods, Vic-Press 304™ may be used on piping systems 1/2" through 2" in size. Pipe shall be ASTM A312 .Schedule 10 type 304/304L stainless steel.. Fittings and couplings shall be precision cold drawn austenitic stainless steel, complete with synthetic rubber O-ring. O-ring grade to suit the intended service. O-rings used on potable water systems shall be EPDM, UL classified in accordance with ANSI / NSF61 for potable water service.

a) Manufacturers of Vic-Press 304™ Fittings: Victaulic Company of America

4. Solder Standard: Solder metal shall conform to the requirements of ASTM B32. Soldering fluxes shall conform to ASTM B813. Solder and fluxes used in drinking water systems shall have a maximum of 0.20-percent lead (Pb) content.

B. Storm, sanitary, drainage, vent pipe and fittings below ground: Service weight cast iron solid pipe and fittings coated with tar and asphaltum. Joints to be packed oakum and molten lead or mechanical joint with resilient gaskets.

C. Garage Waste and Vent Pipe shall be cast iron only as indicated above for the below and above grade. No DWV copper piping shall be allowed.

D. Sanitary sewer piping: From the building drain to the connection to the private sewer system -SDR 35 PVC with hub and gasket joints with ASTM F477 gaskets. Connections to the public sewer shall meet the requirements of the local Public Works municipality.

E. Cold water pipe below ground: Type K soft copper tubing with flared fittings.

F. Compressed Air Piping: above grade: type ‘L’, hard drawn copper with silver brazed copper fittings. Provide brazed to thread fittings for connection of quick-connect gas fittings.

2.04 VALVES

A. All valves in contact with potable water systems must be lead-free or meet the requirements of NSF61G. The model numbers given may not indicate this, but any submitted valve will be reviewed based on meeting the Lead Free law and NSF 61G.

B. Each valve type shall be of same manufacturer and appropriate for service in which used, valves shall be Milwaukee, Watts or Apollo. Valves shall comply with all requirements of the Massachusetts Plumbing and Fuel Gas Code; type proposed for each service shall be submitted for approval. In general, shut-off valves, except for exposed stops at fixtures, shall be ball valves.

C. Each system shall be provided with valves as required by Code and as specified. Valves shall be installed for isolation and to facilitate operation, replacement and repair. Provide access panels where valves are concealed behind non-removable ceilings or walls. Provide shut-off valves for water supply piping to individual fixtures and appliances. All shut-off valves shall be full port ball valves.

D. Ball Valves:

1. On water lines inside the building, ball valves 3 in. and smaller shall be as manufactured by Consolidated Valve Industries, Inc.'s "Apollo" 95-200-03 Series stop and drain with 1-1/4 in. extended stems for piping 1/2 in. to 1 in. size; 77-100/200 Series with 1-1/4 in. extended stems for piping 1-1/4 in. to 2-1/2 in. size. Valves shall be provided with stainless steel ball, reinforced Teflon seats and seals, bronze body, 400 PSI WOG, positive l00 percent shutoff. Valves 4 in. in size shall be equal to "Apollo" 82-24A-01 with extended stem. Ball valves shall be full port style.

2. Drain valves at all low points shall be "Apollo" 78-100 or 78-200 Series, 1/2 in. or 3/4 in. solder by 3/4 in. hose end with attached dust cover cap and chain.

3. Ball valves shall be of one (1) manufacturer, Conbraco Industries, Inc., "Apollo," Watts Regulator or Nibco/Scott.

E. Swing Check – Bronze body, 125 W.S.P., 200 W.O.G.

F. Strainers – Strainers shall be iron body ‘Y’ type with bronze strainers, 250 psig steam and 400 W.O.G. Provide ball valve with hose bib for blow down similar to Watts # B-6000-CC.

G. Balancing Valves:

1. Where indicated on the Drawings, furnish and install Victaulic Tour & Andersson Y-pattern multi-turn globe style valves. Bronze or Ametal copper alloy body, calibrated with differential pressure connection points. Digital handwheel with concealed memory stop to provide full valve closure and re-opening to set position.

2. Balancing valves shall be as manufactured by Tour & Andersson, Nibco or Armstrong.

H. Pressure Reducing Valves:

1. Provide adjustable pressure reducing valves manifold set to maintain a maximum water service discharge pressure of 80 psig at the domestic water service entrance. Valve shall be cast iron body with bronze trim, flange connections, compression diaphragm, and stainless steel springs. Downstream pressure shall not vary more than one pound for every ten pounds of variation in incoming water supply pressure.

2. Provide globe type bypass valve. Install shutoff valve on each side of reducing valve and full-sized bypass with shutoff valve. Install strainer on inlet side of pressure reducing valve. Install pressure gauge on inlet and outlet of valve.

3. Furnish and install, where indicated on the Drawings, Ametek/U.S. Gauge Co.'s Figure P500, 2 in. diameter, 0 lb. to 120 lbs. pressure gauges, complete with petcocks and brass connections.

4. Pressure reducing valves shall be as manufactured by Watts Regulator Co., Wilkins, A.W. Cash Valve Mfg. Co. or Mueller Co..

I. Expansion Tanks: Expansion tanks shall be Taco #PAX series for domestic hot water application. The domestic hot water system expansion tank shall be sized by the Plumbing Contractor/Manufacturer for review by the Architect/Engineer. The expansion tank, although precharged to 40 PSI, should be recharged to the CW inlet water pressure to the domestic hot water system or just under it. Verify expansion tank size with manufacturer before releasing (i.e. have the manufacturer run an expansion tank sizing program).Note: expansion tank size on the drawings was engineered and is sized as required.
   1. Expansion tank shall be as manufactured by Taco, Watts Water Technologies, or Flexcon Industries.

2.05 BACKFLOW PREVENTER

A. Furnish and install the following reduced pressure backflow preventers as manufactured by Watts Regulator:

   1. On cold water service entrance: No. LF009QTS 2 in. complete with bronze strainer; quarter-turn, full port resilient sealed bronze ball valve shut-offs; bronze body construction; ball valve test cocks; captured spring assemblies; modular design; replaceable seats; drain piping with air gap to receptor to floor drain.

   2. On cold water feed to hot water hydronic systems: No. LF909QT-SHW 3/4 in. complete with bronze strainer; quarter-turn, full port resilient sealed bronze ball valve shut-offs; bronze body construction; ball valve test cocks; captured spring assemblies; modular design; replaceable seats; stainless steel check modules for hot water temperatures (up to 210°F); and drain piping with air gap to receptor.

B. Units shall be Watts Regulator Co., Febco, Division of CMB, Inc., Hersey Products, Inc., Conbraco, or Wilkins.

C. The Plumbing Subcontractor shall file and prepare all Applications for Backflow Preventers Testing approval with the Department of Environmental Protection 310 CMR 22.22 and pay all fees and charges.

D. All backflow preventers shall be installed and tested in accordance with Regulation 310 CMR 22.22.

E. Backflow preventers shall be installed to prevent backflow of contaminated water in the potable water supply. On all hose end faucets, such as hose bibs, wall hydrants, service sink faucet, etc.: Watts #8A, non-removable type. On all other equipment: Watts #LF009QT, reduced pressure type.

F. All certificates of approval and test results shall be sent to the Architect-Engineer.

2.06 TRAPS

A. Provide separate traps with integral cleanouts on fixtures and equipment requiring connections to sanitary system. Exceptions are fixtures with integral traps. Traps exposed to view, including connecting drain lines, shall be chrome plated. No trap shall be less than 1-1/2 inch and shall be sized as required by Code.

2.07 INSULATION

A. All hot water, hot water recirculation and cold-water piping shall be insulated with Johns Manville Micro-Lok® AP-T plus fiberglass pipe insulation, Owens-Corning Fiberglas® Pipe Insulation, or Knauf Insulation Earthwool Pipe Insulation. The insulation shall have an average thermal conductivity not to exceed .25 BTU in. per sq. ft. per F. per hour at a mean temperature of 75 degrees F. Thickness of the insulation shall be 1/2 in. for all cold water piping up to and including 2 in., 1 in. thick for hot water and hot water recirculating piping. Jacket shall be Johns Manville Zeston® 2000 PVC or Knauf Insulation, insulated fitting covers and jacketing. The insulation shall be applied over clean dry pipe with all joints butted firmly together. Longitudinal jacket laps and the butt strips shall be smoothly secured with Benjamin Foster 85-20 adhesive.

B. All fittings and valves shall be insulated with the proper factory pre-cut fiberglass insulation and covered using the factory, pre-molded, one-piece PVC fitting covers secured with flexible off-white 10 mil polyvinyl chloride film bonded with a specially formulated adhesive that can be installed indoors and out with a strong permanent bond conforming to MIL Spec. No. 7798-A.

C. All exposed supply and waste piping to handicapped lavatories or sinks shall be insulated with Truebro Model 101W or 102W "Handi-Lav-Guard" trap and hot water insulation kits with accessory no. 105, Zurn ADA Trap Wrap, or Plumberex Trap Gear.

D. All exposed insulated piping, in public areas and storage areas, 10 ft. 0 in. up from finish floor shall be provided with an additional jacket made of high impact polyvinyl chloride 10 mil thickness, applied over herein before specified insulation, using vapor barrier mastic-adhesive.

E. All buried trap primer, hot and cold-water piping shall be insulated with 1/2 in. foamed plastic insulation similar to Manville "Aerotube", Armacell, or Armaflex.

F. Tempered water lines serving emergency eye-face wash equipment shall be insulated as for cold water piping.

G. Insulation shall be Johns Manville, Owens-Corning, CertainTeed Corp., or Armstrong.

2.08 HANGERS

A. Hangers shall support piping from building structure to maintain required grade and pitch of pipe lines, prevent vibration, secure piping in place and provide for expansion and contraction. Hangers shall be adjustable clevis type; trapeze hangers may be used where conditions permit.

B. Hanger spacing shall conform to requirements of state and local plumbing codes; in no case shall horizontal piping be supported at intervals greater that 8 ft.

C. Hanger rods shall be connected to beam clamp as required to attach to the building construction. No ram-set or shot shields will be allowed.

2.09 CLEANOUTS

A. Cleanouts shall be provided in soil and waste pipes at changes in direction, where shown on Drawings, and at other points required by Code so that lines will be readily accessible for cleaning or rodding out; provide a minimum of 24 inch clearance for rodding. Cleanouts shall be same size as pipe in which they are installed but not larger than four inches.

B. Cleanouts shall be installed so that cleanout opens in direction of flow of drainage line served or at right angles thereto. Cleanout plug shall be kept free of dirt and construction materials and shall not be covered with cement, plaster or other permanent finishing materials.

C. Floor cleanouts shall have cast iron body and frame with square adjustable scoriated secured nickel bronze top. Unit shall be vertically adjustable for a minimum of two inches. When waterproofing membrane is used, provide clamping collar. Cleanouts shall consist of "Y" fittings and 1/8 inch bends with brass or bronze screw plugs. Cleanouts in tile floors shall have square top covers recessed for tile insertion; in carpeted areas, provide carpet cleanout markers.

D. Provide cleanouts a base of vertical stacks with cleanout plug located approximately 30 inches above floor. Extend cleanouts to wall with access covers. Cleanout shall consist of sanitary tees. Furnish nickel-bronze square frame and cover with minimum opening 6 x 6 inches at each wall cleanout.

E. In horizontal runs above grade, cleanouts shall consist of cast brass screw plug in fitting or in caulked cast iron ferrule. No-hub end-cap is not allowed.

2.10 JOINTING COMPOUNDS

A. Provide pipe dope, Teflon tape, wax rings, neoprene gaskets and other jointing compounds as required by best standard practice and only on service as recommended by the manufacturer. Work shall conform to manufacturer's recommendations with regard to use of putties, jointing compounds or both in installing plumbing fixtures and trim.

2.11 WATER HAMMER ARRESTORS

A. Maintenance free water hammer arrestors shall be furnished and installed at all locations in the water systems where quick acting valves are installed as well as wherever water hammer may occur. Examples of such locations are as follows:
   1. End of long runs of water piping ending @ hose bibs or sillcocks.
   2. Flush Valves.
   3. Quick-closing/metering Faucets.
   4. Clothes Washer Connections.

B. Water hammer arrestors shall be as manufactured by Josam Manufacturing Company, J.R. Smith Manufacturing Company, Zurn Systems or Precision Plumbing Products, Inc. Arrestors shall be installed at each and every multiple of fixtures or items as listed above, water hammer arrestors may serve groups of fixtures. Sizing and placement shall be in accordance with PDI Standard PDI-WH-201 and the manufacturer's recommendations. Provide access panels.

C. Water hammer arrestors shall be as follows:

Type	Fixture Unit Rating	Model	WHA #
1. SA "A"	1-11	Jay R. Smith 5005	100
2. SA "B"	12-32	Jay R. Smith 5010	200
3. SA "C"	33-60	Jay R. Smith 5020	300
4. SA "D"	61-113	Jay R. Smith 5030	400

2.12 INDIRECT FIRED WATER HEATER, IWH-1

A. Furnish and install one (1) indirect fired domestic water heater similar to Heat Transfer Products model #SSU-119C or TurboMax model #109 as manufactured by Thermo 2000 Inc. Water heater shall have a 119-gallon storage capacity. See schedule on drawings for performance requirements. Acceptable manufacturers are Heat Transfer Products Inc., Cemline Corporation, A.O. Smith Water Products Co., Thermo 2000 Inc. or approved equal.

B. The water heaters shall be equipped with copper piping in the form of parallel helicoidal lines with a maximum operating pressure of 150 psi. All copper components will adhere to the NSF 61 standard from the NSF International Standard Drinking Water Systems Components Health Effects document. All copper components shall be welded with a lead-free silver Sillfoss solder component. The water heater shall be equipped with a patented steel injector, located on top of the tank, to act as a boiler water inlet (primary circuit), and with a steel collector, located at the bottom of the tank, to act as a boiler water outlet. The tanks shall be made of high-carbon steel. All joints shall be arc-welded using a MIG/argon process. The tank shall have a maximum operating pressure of 150 psi and shall undergo a 300 psi hydrostatic test. The boiler shall be wrapped in a glass fiber insulating jacket limiting thermal loss to 1/2°F per hour. The outer shall be epoxy-coated. The water heater shall be equipped with a thermostat (aquastat) that makes contact when the temperature falls below the tank water temperature set point minus an adjustable differential (10 to 40°F) and breaks contact when the temperature rises over the set point (95 to 195°F). The tank shall be equipped with a brass drain cock with a maximum operating pressure of 150 psi. Three adjustable supports shall allow the leveling of the unit. The boiler shall be shipped from the plant equipped with a safety relief valve as per the ASME code, adjusted to a 50 psi setting, a thermo-manometer and an automatic air bleeder. The water heater is protected by a 10-year warranty. The water heater shall be ASME rated.

2.13 PRESSURE GAUGES AND THERMOMETERS

A. Provide Bourdon tube pressure gauges where shown on the drawings or specified, H.O. Trerice, Dwyer, or Marshalltown. Gauges shall have white faces with black lettering. Gauge bodies shall be set in iron cases with baked enamel finish. Provide syphons and shut-off cocks.
   1. Gauges shall be easily accessible and easily read. Minimum dial size shall be 4 1/2 inch. Gauge graduations shall meet limit requirements of normal operation; gauge shall indicate at midscale.

B. Provide separable well V-case thermometers where shown on Drawings or where specified, H.O. Trerice, Dwyer, or Marshalltown. Thermometers shall have 9 inch scale, white face and black letters. Thermometers shall be angular or straight-

stemmed as conditions necessitate. Thermometer wells shall be bronze, monel or stainless steel. Range shall be as required by limit or normal operation.

2.14 HOSE BIBBS & SILL COCKS

A. Interior hose bibbs shall be Woodford Model 24, Josam, or Zurn, chrome plated, vacuum breaker, hose connection, loose T key. Provide one in the toilet room and at various locations throughout the garages as shown.

B. Sill cocks shall be Woodford model B65, Josam or Zurn, non-freeze type, recessed box with chrome plated face, vacuum breaker, hose connection, integral stop and loose T key.

2.15 FLOOR DRAINS

A. Provide floor drains of the type specified hereinafter; drains shall be Jay R. Smith, Josam, Zurn, or Watts Drainage. Provide suitable clamping device and extensions if required, where installed in connection with waterproofing membrane.

B. FD-1: Zurn ZB415-5B-P (Josam Model 3000*-A-2-50) round top or equal, coated cast iron floor drain, two-piece body with double drainage flange, invertable non-puncturing flashing collar, weepholes, polished bronze strainer head, (Nikaloy round SUPER-FLO grate), ½" trap primer connection, bottom outlet size varies (see plans); tile flange if required by floor type.

B. FD-2: Zurn model #Z507-P-Y 7" medium duty floor drain, round top, Dura-Coated cast iron body with bottom outlet, seepage pan and combination membrane flashing clamp and frame for medium-duty cast iron deep flange slotted grate, trap primer connection, sediment bucket.

C. FD-3: Zurn model #Z886-HDS-U2-RFSC trench drain, 24'-0" long; each precast polyester polymer concrete one meter unit shall have a 0.6% built-in slope and a permanently cast-in integral galvanized steel rail with a maximum edge thickness of 0.1". The integral cast-in metal rail shall provide mechanical support as a one-part unit which can support a 10 ton hard rubber wheel load and 60 ton gross vehicle weight. All metal material used in grate and rail construction shall be a minimum of 0.1" thick. Channel profile shall include positive interlocking tongue and groove connections which can be water sealed to provide water tight connections. Locking device recesses are formed into the reinforced channel walls. All locking device recess material construction shall be polymer concrete. Grate system shall be ductile iron slotted grate with stainless steel locking bolts (2 per grate) and angle iron frame, open area = 36.00 square inches per 18" grate. Bottom outlet location as shown on plan.

D. FD-4: Same as FD-3 except 31’-0” long.

E. FD-5: Same as FD-3 except 66’-0” long.

F. FD-6: Architectural Floor Drain by G.C. Plumber to provide p-trap and standpipe in pit to drain.

2.16 TEMPERING/MIXING VALVES

A. Provide thermostatic mixing/tempering valves of the type specified hereinafter; mixing valves shall be Leonard Valve Company, Bradley, Symmons, Haws or Armstrong.

B. MV-1: For the 112 degree F water for the wall hung lavatories and showers, provide thermostatic mixing valve for hot and cold water supply to fixtures as specified below.
   1. Furnish and install at the water heater one (1) Honeywell Sparcomix model AM101LF-US-1 anti-scald proportional thermostatic mixing and diverting valve. The mixing valves shall have the following features:
      a. Dual certification ASSE 1016 – T and ASSE 1017.
      b. Constant water temperature under different operating conditions.
      c. Proportional valve (simultaneous control of hot and cold water).
      d. Anti-scald, Anti-chill thermal shock protection at correct setting.
      e. Temperature high limit or low limit range restriction.
      f. Nickel plated brass/bronze construction, EPDM o-rings.
      g. Straight through design.
      h. Maximum working pressure = 150 PSI.
      i. 3/4” union sweat connection.
      j. Low minimum flow requirement = 0.5 GPM.
      k. Rated at 12 GPM with a Cv of 3.8 at a temperature range of 100ºF to 145ºF.
      l. Made in the US.

C. MV-2: Furnish and install, where indicated on the Drawings, Leonard Valve Co.'s Type TM-850-LF assembly. It shall have the following features:
   1. DURA-trol® solid bimetal thermostat directly linked to valve porting.
   2. DURA-trol® is highly responsive and cannot be damaged by extremes in temperature.
   3. Primary valve can be set to the correct temperature for the application.
   4. Locking temperature regulator to prevent accidental movement set for 85°F.
   5. Primary mixing valve will close down on failure of cold water supply.
   6. Primary mixing valve with special internal cold water bypass capable of 20 GPM @ 30 PSI upon failure of hot water supply.
   7. Adjustable high temperature limit stop set for 90°F.
   8. Dial thermometer (range 0 to 140°F.

9. Union Angle checkstops with strainers on inlets.
10. Secondary Thermostatic Control factory locked @ 90°F (adjustable) to allow cold water to enter the outlet side of the Primary mixing valve.
11. Rough bronze finish.

2.17 HOT WATER CIRCULATING PUMP

A. Furnish and install all bronze construction circulation pump, as follows:

1. Pump No. (RP-1) 110 degrees – Hot Water Recirculation for building: Furnish and install for EWH-1, Taco Model #0014-SF1-IFC stainless steel circulating pump, 1/8 HP, 3250 RPM, 1 phase, 115 volt motor with built-in overheat protection, to deliver 2.0 GPM at 10 ft. head. The pump shall have an integral flow control fitting.

2. Pump No. (RP-2) 70 degrees – Hot Water Recirculation for fixture P-16: Furnish and install for EWH-1, Taco Model #0014-SF1-IFC stainless steel circulating pump, 1/8 HP, 3250 RPM, 1 phase, 115 volt motor with built-in overheat protection, to deliver 2.0 GPM at 10 ft. head. The pump shall have an integral flow control fitting.

B. The pumps shall be controlled by a time clock. Time clock shall be furnished, wired, and installed by the Electrical Subcontractor.

C. Circulating pump shall be Taco, ITT Bell & Gossett Co., or Grundfos, Inc.

2.18 PIPE IDENTIFICATION AND VALVE TAGS

A. All piping, except that piping which is within inaccessible chases, shall be identified with semi-rigid plastic identification markers similar to Seton, PipeMarker or Emedco pipe markers. Directions of flow arrows are to be included on each marker. Each marker background shall be appropriately color coded with clearly printed legend to identify the contents of the pipe in conformance with the “Scheme for the Identification of Piping Systems” (ANSI 13.1-1981). Setmark snap-around markers shall be used above six inch overall diameters up to six inches and strap-around markers shall be used above six inch overall diameters. Markers shall be located adjacent to each valve, at each branch, at each cap for future, at each riser take off, at each passage through wall, at each pipe passage through floors, at each pipe passage to underground and on vertical and horizontal piping at 20 foot intervals maximum. All non-portable water lines and outlets shall be identified in accordance with the requirements of the Massachusetts Uniform State Plumbing Code.

B. All valves shall be designated by distinguishing numbers and letters carefully coordinated with a valve chart. Valve tags shall be 19 gauge polished brass, 1-1/2 inch diameter with stamped black filled letters similar to Seton S type 250-BL, Marking Services Inc. or Pipemarker. Lettering shall be 1/4 inch high for type service and 1/2 inch for valve number. Tag shall be attached to valves with approved brass "S" hooks, or brass jack chin. Whenever a valve is above a hung ceiling, the valve tag shall be located immediately above the hung ceiling.

C. Furnish a minimum of two typed valve lists to be framed under glass or plexi-glass. Each chart shall be enclosed in an approved .015-inch thick plastic closure for permanent protection. Valve numbers shall correspond to those indicated on the Record Drawings and on the printed valves lists. The printed list shall include the valve number, location and purpose of each valve. It shall state other necessary information such as the required opening or closing of another valve is to be opened of closed. Printed framed valve lists shall be displayed in each Mechanical Room or in location designated by the Owner.

D. Equipment nameplates shall be 3/4 inch by 2-1/2 inch long .02-inch aluminum with a black enamel background with engraved natural aluminum letters similar to Seton Style 2065-20. Nameplate shall have pressure sensitive taped backing.

E. Provide a brass will plaque, minimum .020-inch thickness, secured to the exterior wall just above the grade line for all buried serviced entrances or exits. Samples of such are: Water Service Below; Sanity Sewer Below; Kitchen Waste Below; Storm Drain Below; etc.

2.19 AUTOMATIC TRAP PRIMER VALVE

A. Furnish and install automatic trap primer where indicated or required as manufactured by Precision Plumbing Products, Model P-1 or P-2, as noted on the Drawings, with vacuum breaker and adjustment set screw.

B. Provide distribution unit(s) as required to supply multiple floor drains as manufactured by Precision Plumbing Products.

2.20 AIR COMPRESSOR

A. Furnish and install Ingersoll Rand model #2475N7.5-FP, two-stage air compressor, 7.5 HP with 80 gallon air receiver. It is a fully packaged system rated for 24 CFM @ 175 PSI, 230V-1Ø power. The unit shall have the following features:

1. Fully packaged:
   a. E-series motor started (mounted and wired).

b. Relief valve & discharge ball valve (mounted and piped).
c. Air cooled aftercooler (mounted and piped).
d. Low oil level shutdown (mounted and wired).
e. Electric drain valve (mounted and piped).
f. Automatic start/stop control with pressure switch.

2. Continuous-Duty Operation:
   a. 100% cast-iron cylinders and pump.
   b. Oversized cast-iron balanced belt wheel.
   c. Oversized industrial-grade bearings.

3. V-Block Deep Finned Cylinders:
   a. Provides 360 degrees cooling for lower operating temperatures.

B. Alternate Air Compressor manufacturers are Quincy, Champion by Gardner Denver or Kaeser.

2.21 REFRIGERATED AIR DRYER

A. Furnish and install refrigerated air dryer similar to Ingersoll Rand Nirvana with a capacity of 24.2 SCFM. The unit shall be rated for 1/5 HP, 450 Watts, 115V-1Ø and use refrigerant R134a. The unit shall have the following features:

1. Integral Heat Exchanger/Separator - Compact and corrosion resistant, this unique assembly provides efficient air drying while minimizing dryer footprint.

2. VSD Fan Operation - Variable speed condenser fan control modulates fan speed in relation to dryer load. Slowing the speed of the fan under low load conditions saves energy. Additionally, long-term reliability is improved because fewer components are required within the refrigeration circuit.

3. Microprocessor Control - Dryer functions and drain operation are microprocessor controlled. LED display provides visual indication of dryer operating status. A touchpad user interface permits easy manipulation of all dryer parameters.

B. Alternate Refrigerated Air Dryer manufacturers are Ingersoll Rand, Quincy, Atlas Copco or Kaeser.

C. As an alternate to the refrigerated air dryer, the contractor can use an in-line desiccant. Three (3) spare desiccant replacements are required.

2.22 COMPRESSED AIR ACCESSORIES

A. Furnish and install Ingersoll Rand Air Filters, Allied Group Inc. or Parker Balston as follows:

1. The high efficiency filter is designed to remove liquids and solids from compressed air. The filter removes particles down to 0.01 micron – liquids down to 0.01mg/m^3 at 21°C (0.01 ppm W at 70°F). The initial dry pressure drop at rated flow will not exceed 1 psig, where as the initial wet pressure drop will not exceed 3 psig.
2. These filters should be preceded by a GP pre-filter. The HE series is especially suited for application such as protecting instrumentation systems and gauging equipment, air bearings, advanced pneumatics and in sophisticated process and electronic plants.
3. The filter utilizes the coalescing method for removing contaminants. The filter elements are long lasting and easy to install. They are constructed of multi-layered borosilicate microfibre media; glass filled nylon end caps, and perforated stainless steel inner and outer support cores.
4. The housing is constructed of either pressure die-cast aluminum or pressure vessel quantity steel. The filter has an automatic drainage system for constant removal of contaminants. It also has a differential pressure indicator visible from both sides of ease of installation.
5. The lift and twist mechanism makes for easy element exchange. The durable stainless steel element inner and outer cores will withstand sudden pressure surges of up to 100 psig. The element top end seal and patented tapered location that ensures a perfect seal.

B. Provide a ball valve at base of the receiver tank for manual drain off of moisture.

C. Connections to the air compressors shall be made with flexible braided stainless steel connectors.

D. Provide quick-connect fittings for compressed air equipment connections.

E. Provide Safety Excess Flow Check Valve for compressed air system drops similar to Coilhouse Pneumatics #SV804 ½" pipe size. The safety excess flow check valve is designed to automatically shut off air flow upon a sudden break in the air line, thereby protecting personnel and property from "whipping" air hoses. Allows full unrestricted flow of air while in normal (open) position. Entire unit is corrosion free. It automatically re-sets itself after repair is made. Unit is tamper-proof. Meets OSHA safety regulations.

2.23 COMPOUND TYPE COLD WATER METER – DOMESTIC WATER SERVICE

A. The Montague Department of Public Safety (DPS) will supply the water meter. The water meter will connect by wire to a transceiver located on the outside of the

building. The Montague DPS will supply the cable. Plumbing Contractor to install the cable from the meter to a location outside as requested by the owner.

2.24 MDC CATCH BASIN GASOLINE TRAP

A. Provide Commonwealth of Massachusetts Plumbing Board approved Gasoline, Oil and Sand Separator on garage waste system. Circular basin shall be three and one-half feet diameter (42") minimum, and the tank depth below the inlet pipe shall be 5'-10". Basin shall be solid concrete precast with water-tight connections with all concrete consisting of one-part concrete and two-parts sand. Cement brick, hollow concrete, or cinder block masonry products shall not be used.

B. The separator is to be located outside of a building where possible and the cover is to incorporate a center-hole. A sealed tight cover is to be used if the separator is located inside of a building. The cover shall be no less than 24" diameter. The separator shall be located and constructed to prevent surface or sub-surface water from entering. The inlet pipe shall be no less than four inches above the water line level. When the separator is subject to freezing, it shall be set a minimum of three feet below grade. The separator shall be filled with water and leak tested before being introduced into service. The non-corrosive steps shall be spaced at 18" apart. The chamber vent and outlet vent shall return to the inside of the building and extend through the roof.

PART 3 - EXECUTION

3.01 SPECIAL RESPONSIBILITIES

A. Cooperate and coordinate with other trades in executing work of this Section. Perform work such that progress of entire project including work of other trades shall not be interfered with or delayed. Provide information on items furnished under this Section to be installed by other Sections.
   1. Obtain detailed information from manufacturers of equipment as to proper method of installation. Give full information so that openings required for work of this Section may be coordinated with other work and other openings and many be provided for in advance. In case of failure to provide information, cutting and patching will be done at the expense of this Section to the satisfaction of the Architect.
   2. Notify Architect of location and extent of existing piping and equipment not shown on the Drawings which interferes with new construction. With approval of Architect, relocate existing equipment to permit new work to be installed as required by Contract Documents. With approval of Architect, remove non-functioning or abandoned piping and equipment.

B. During progress of work, remove and properly dispose of resultant dirt and debris and keep premises reasonably clean. Upon completion of work, remove equipment and unused material provided for work.

C. Conduct work so as not to interfere with functioning of existing sewer, water and gas mains. Extreme care shall be observed to prevent debris from entering piping. Confer with Architect as to disruption of water service or there utilities due to testing or connection of new work to existing.

3.02 MATERIALS AND WORKMANSHIP

A. Work shall be executed in a workmanlike manner and shall present neat appearance when completed. Piping shall rum concealed except in mechanical rooms and areas where no hung ceiling exists. Material and equipment shall be installed according to manufacturer's recommended best practice.

B. Materials and equipment shall be new, unless otherwise noted, and supplies, appliances and connections necessary for complete and operational installation shall be provided.

C. Finish of materials, components and equipment shall not be inferior to industry good practice. Owner shall not be responsible for material and equipment before testing and acceptance.

3.03 ESCUTCHEONS

A. Escutcheons shall be installed around exposed pipe passing through finished floor, wall or ceiling. Escutcheons shall be heavy cast brass, chrome-plated, adjustable, of sufficient outside diameter to cover sleeve opening and to fit snugly around pipe or insulation.

3.04 SLEEVES AND INSERTS

A. Sleeves for piping between floors and through fire walls or smoke partitions shall be installed with approved packing between sleeves and piping to provide firestop.

B. This contractor is responsible for sleeving all pipe penetrations before pouring of slab. If additional holes are required this contractor shall core drill such holes in coordination with the general contractor and with prior consent of the Architect.

3.05 INTERIOR WATER SUPPLY SYSTEM

A. Water supply piping shall be run as indicated on the Drawings, including new connections to mains and supplies to fixtures. Connections to fixtures shall be from top of mains and piping shall be pitched at least 1 inch in 40 feet in the direction of flow so that it can be drained completely at low points. Provide drain valves where necessary. Piping shall be pitched up towards fixtures for proper air relief.

B. All copper tubing shall be cut true with cutters; the ends shall be reamed out to the full inside diameter of the pipe. Cap all open ends to prevent the entrance of debris.

C. Provide water hammer arrestors of proper size and type at end of each water branch with flush valves and as shown on the drawings.

D. Provide ball type shut-off valves on water branches to individual areas and to each bathroom group.

3.06 SANITARY, DRAINAGE AND VENT PIPING

A. Interior horizontal sanitary and drainage piping shall be installed in practical alignment at uniform grade of 1/8 inch per foot minimum up to1/4 inch per foot if possible or if required by code such as for waste piping smaller than 4". Piping within building shall be coordinated closely with the work of other trades, in particular the HVAC ductwork.

B. All changes in pipe size and direction on waste lines shall be made with Y's and cleanouts, reducing fittings or recessed reducers. Y's and 45° fittings, or 45° combination fittings shall be used wherever possible.

C. When installing a fitting or making repairs to an existing soil stack, vent stack or storm drain, said fittings or repairs shall be made of the same material as the existing stock or drain using the same jointing method.

3.07 VENTS THROUGH ROOF

A. All vents extending through the roof which serve the sanitary and waste systems shall extend to no less than 18" and no more than 24" above the roof.

B. No vent terminal shall be located directly beneath any door, window, or other ventilating opening of the building or of any adjacent building, nor shall any vertical terminal be within 10 feet horizontally of such an opening unless it is at least 2 feet above the top of such opening.

3.08 JOINTS AND CONNECTIONS

A. Joints and connections of piping shall be made permanently gas and water tight.

B. Dielectric couplings or unions shall be used where dissimilar piping materials are joined.

C. Final plumbing and gas connections to all equipment furnished or installed by others shall be by this Section.

3.09 INSTALLATION OF EQUIPMENT

A. Install equipment to avoid interference with structure and work of other Sections, preserve adequate headroom and clear doors and passageways, to satisfaction of Architect, and in accordance with Code requirements. Installation shall permit clearance for access to equipment for repair, servicing and replacement.

B. Manufacturer's Recommendations: Where installation procedures or any part thereof are required to be in accordance with the recommendations of the manufacturer of the equipment being installed, printed copies of these recommendations shall be furnished to the Architect prior to installation.

3.10 DISINFECTION

A. The domestic water distribution piping system shall be thoroughly disinfected with solution containing not less than 50 parts per million of available chlorine. Solution shall be introduced into system for period of eight hours, during which time valves and faucets shall be opened and closed several times. After disinfection, solution shall be flushed from system with clean water until residual chlorine content is not greater than 0.2 parts per million.

3.11 CLEANING

A. Upon completion of work but prior to final system testing, all parts of installation shall be thoroughly cleaned. Fixtures, pipe, valves and fittings shall be completely cleaned of grease, metal cuttings, dirt, etc. Protective covers shall be removed and fixtures shall be cleaned and ready for use.

3.12 TESTING

A. Provide testing of plumbing systems as required by authorities having jurisdiction, including Owner and Architect. Tests shall be conducted as part of work of this Section and shall include labor, equipment, apparatus and services required to perform tests.

B. Prior to final acceptance, furnish Architect with certificates of testing and inspection for plumbing systems indicating approval of authorities having jurisdiction and conformance with requirements of Contract Documents.

C. Notify Architect and authorities involved at lest 48 hours prior to testing and inspection. Do not paint, cover or conceal work prior to testing, inspecting and obtaining approval.

D. Provide temporary piping and connections for testing, flushing or draining systems to be tested. Leaks, damage or defects discovered or resulting from test shall be repaired or replaced to like-new condition. Piping must be absolutely tight before it will be accepted and joints shall be made tight without caulking.

E. Tests for Plumbing Systems: Soil, waste, vent, gas, and water piping shall be tested by the Plumbing Subcontractor and approved before acceptance. Underground soil, rain conductor, and waste piping shall be tested prior to backfilling. Equipment required for tests shall be furnished by the Plumbing Subcontractor at no additional cost to the Owner. All tests shall be witnessed and approved by the Plumbing Inspector.

F. Drainage And Venting System Piping: All vent, soil, waste, acid waste, acid vent, and rain conductor shall be tested with water or air before the fixtures are installed.

1. Water Test: Water test shall be applied to the drainage and venting system in their entirety or in sections. If the entire system is tested, all openings in the pipe shall be tightly closed, except the highest opening, and the system shall be filled with water to the point of overflow. If the system is tested in sections, each opening, except the highest opening of the section under test, shall be tightly plugged and each section shall be filled with water and tested with at least a 10 ft. head of water. In testing successive sections, at least the upper 10 ft. of the next preceding section shall be tested so that each joint of pipe in the building, except the uppermost 10 ft. of the system, has been submitted to a test of at least 10 ft. head of water. The water shall be kept in the system, or in the portion under test, for at least two (2) hours before the inspection starts. The system shall be tight at all joints.

2. Air Test: If tests are made with air, a pressure of not less than 5 lbs. per sq. in. shall be applied with a force pump and maintained at least one (1) hour without leakage.

G. Water System: When the roughing-in is complete, and before fixtures are set, the entire hot water recirculation and cold water piping system shall be tested at a hydrostatic pressure of not less than 125 PSI gauge and proved tight at this pressure for not less than four (4) hours in order to permit inspection of all joints. Where a portion of the water piping system is to be concealed before completion, this portion shall be tested separately as specified for the entire system. All water entrance piping up to PRV-station shall be tested at 50 PSI in excess of the street pressure, but not to exceed 200 PSI.

H. Defective Work: If inspection or test indicates defects, such defective work or material shall be replaced or repaired as necessary and inspection and tests repeated. Repairs to piping shall be made with new materials. No caulking of screwed joints or holes will be acceptable.

3.13 ACCESS AND ACCESS PANELS

A. Perform work so as to provide proper access to material or equipment which may need inspection, replacement, repair or service. If proper access cannot be provided, confer with Architect as to best method for minimizing effect of reduced access.

B. Furnish access panels for installation under other Sections where controls, valves, or other items requiring access are concealed in floor, wall, furred space or above ceiling.

C. Lay-in tile ceilings do not require access panels. Locations of devices shall be marked with thumbtack on finish ceiling panel and noted on record drawings.

D. Access panels shall be Milcor, Knapp or Loctor; coordinate with other Sections providing similar panels. Access panels shall have UL rating conforming to requirements of area in which they are installed. The panel(s) shall be adequate to allow for complete access to the concealed equipment; minimum size shall be 12 x 12 inches. The panels shall be factory fabricated completely flush with heavy metal door and frame.

E. Frames shall be welded construction of not less thank 14 gauge steel, with hinges set flush with frame, and shall be secured in a closed position; key locked panels will not be accepted. In toilet rooms and other wet locations, access panels shall be constructed of stainless steel.

3.14 PAINTING

A. Equipment installed under this Section shall have shop coat of non-lead gray paint, unless otherwise specified. Hangers and supports shall have one coat of non-lead red

primer. Machinery shall be stenciled with equipment name. Finish painting, including painting of pipe systems, shall be done under other Sections.

3.15 LUBRICATION

A. After complete installation by the Contractor of any equipment which depends on lubrication for efficient operation, the Contractor shall properly lubricate per instructions of the manufacturer. This shall be done before any test runs or final operation.

3.16 LABELING

A. Provide pipe markers of either pressure sensitive tape or laminated plastic, color coded and indicating the type and direction of flow of the plumbing service. All exposed CW, HW and gas piping exposed shall be labeled.

3.17 ELECTRIC ROOMS

A. Piping shall not be installed in or through Electric Rooms, Electrical Closets, Transformer Room, Telephone Room or Elevator Machine Rooms unless the piping is intended to serve these rooms. No piping shall be installed over electrical panels.

3.18 FLOOR DRAINS

A. Floor drains shall be furnished and installed by this contractor; he shall be responsible for correctly setting these drains to the proper grade to assure proper drainage from all surrounding areas. Sizes of drains shall be the same size as the pipe it serves.

B. Trench drain installation:

1. Site preparation: Excavate the area for channel placement wide and deep enough to accommodate the standard channel size and a minimum of 4” concrete encasement on both sides as well as underneath the channel. Channels require a minimum of 4” of concrete support and top of channel must be evenly aligned to the surface of the surrounding slab.

2. Installation: Channel sections are installed from the outlet end of the system, working from either catch basin: or deeper channel sections to shallow channel sections. Insert channels from above to allow ends to interlock. Channel sections shall be placed on brick, rebar basket, Channel Chair low slump concrete, grout slurry, or suspended to obtain correct finished elevation. Cutting will be made, if

required, by masonry or concrete saw. Temporary place grate in channel to avoid compression during concrete placement.

3. Concrete Placement: Protect grates and channel interior during pouring concrete. Place concrete in a manner that will not dislodge the channels. Concrete shall be at finished level or 1/8” above the top of the channel to ensure efficient drainage and adequate channel edge protection.

4. Finishing and clean-up: Following final set of concrete, remove grate protection, place grates in final position and engage locking bolts in correct location.

3.19 WALL HYDRANTS

A. Hydrants shall be set approximately 18 inches above outside grade and shall include cross connection protection. Loose key stops shall be turned over to the Owner prior to completion.

END OF SECTION 22 00 01

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SECTION 22 08 00

COMMISSIONING OF PLUMBING
(Filed Sub Bid Required as Part of Section 22 00 00)

PART 1 - GENERAL

1.01 SUMMARY

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 1 – GENERAL REQUIREMENTS, which are hereby made a part of this Section of the Specifications.

B. Section includes commissioning process requirements for Plumbing systems, assemblies, and equipment.

A. **Work in this Section is included as part of the work in Section 22 00 00**.

1.02 RELATED SECTIONS

A. Section 01 77 00, PROJECT CLOSEOUT PROCEDURES.

B. Section 01 91 13, GENERAL COMMISSIONING.

C. Section 22 00 01, PLUMBING.

1.03 DEFINITIONS

A. Commissioning Plan: A document that outlines the organization, schedule, allocation of resources, and documentation requirements of the commissioning process.

B. CA: Commissioning Agent/Commissioning Authority. An entity who leads, plans, schedules and coordinates the Cx team to implement the Cx process.

C. Systems, Subsystems, Equipment, and Components: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, equipment, and components.

1.04 SUBMITTALS

A. Certificates of readiness.

B. Certificates of completion of installation, prestart, and startup activities.

1.05 ALLOWANCES

A. Labor, instrumentation, tools, and equipment costs for technicians for the performance of commissioning testing.

1.06 CONTRACTOR'S RESPONSIBILITIES

A. Perform commissioning tests at the direction of the CA.

B. Attend construction phase controls coordination meeting.

C. Attend testing, adjusting, and balancing review and coordination meeting.

D. Participate in Plumbing systems, assemblies, equipment, and component maintenance orientation and inspection as directed by the CA.

E. Provide information requested by the CA for final commissioning documentation.

F. Provide measuring instruments and logging devices to record test data, and provide data acquisition equipment to record data for the complete range of testing for the required test period.

1.07 COMMISSIONING AGENT'S RESPONSIBILITIES

A. Provide Project-specific construction checklists and commissioning process test procedures for actual Plumbing systems, assemblies, equipment, and components to be furnished and installed as part of the construction contract.

B. Direct commissioning testing.

C. Verify testing, adjusting, and balancing of Work are complete.

D. Provide test data, inspection reports, and certificates in Systems Manual.

1.08 COMMISSIONING DOCUMENTATION

A. Provide the following information to the CA for inclusion in the commissioning plan:
   1. Plan for delivery and review of submittals, systems manuals, and other documents and reports.
   2. Identification of installed systems, assemblies, equipment, and components including design changes that occurred during the construction phase.

3. Process and schedule for completing construction checklists and manufacturer's prestart and startup checklists for Plumbing systems, assemblies, equipment, and components to be verified and tested.
4. Certificate of completion certifying that installation, prestart checks, and startup procedures have been completed.
5. Certificate of readiness certifying that Plumbing systems, subsystems, equipment, and associated controls are ready for testing.
6. Test and inspection reports and certificates.
7. Corrective action documents.
8. Verification of testing, adjusting, and balancing reports.

PART 2 -PRODUCTS (NOT USED)

PART 3 -EXECUTION

3.01 TESTING PREPARATION

A. Certify that Plumbing systems, subsystems, and equipment have been installed, calibrated, and started and are operating according to the Contract Documents.

B. Certify that Plumbing instrumentation and control systems have been completed and calibrated, that they are operating according to the Contract Documents, and that pretest set points have been recorded.

C. Certify that testing, adjusting, and balancing procedures have been completed and that testing, adjusting, and balancing reports have been submitted, discrepancies corrected, and corrective work approved.

D. Testing Instrumentation: Install measuring instruments and logging devices to record test data as directed by the CA.

3.02 TESTING VERIFICATION

A. Prior to performance of testing and balancing Work, provide copies of reports, sample forms, checklists, and certificates to the CA.

B. Notify the CA at least 10 days in advance of testing and balancing Work, and provide access for the CA to witness testing and balancing Work.

C. The CA will review contractors FPT procedures prior to execution for the following specific systems, assemblies, and components:
   1. Plumbing fixtures and equipment.
   2. Domestic hot water equipment and systems.

D. Acceptance criteria and test details will be in accordance with the related sections including the following:
   1. Section 01 91 13 Commissioning General Requirements for general commissioning process activities.
   2. Section 22 00 01 – Plumbing.

E. Provide technicians, instrumentation, and tools to verify testing of Plumbing systems at the direction of the CA.

3.03 GENERAL TESTING REQUIREMENTS

A. Provide technicians, instrumentation, and tools to perform commissioning test at the direction of the CxA.

B. Scope of Plumbing testing shall include entire Plumbing installation, from central distribution, DHW generation and storage, and fixtures. Testing shall include measuring capacities and effectiveness of operational and control functions.

C. Tests will be performed using design conditions whenever possible.

D. Simulated conditions may need to be imposed using an artificial load when it is not practical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by the CA and document simulated conditions and methods of simulation. After tests, return settings to normal operating conditions.

E. If tests cannot be completed because of a deficiency outside the scope of the Plumbing system, document the deficiency and report it to the Owner. After deficiencies are resolved, reschedule tests.

F. If the testing plan indicates specific seasonal testing, complete appropriate initial performance tests and documentation and schedule seasonal tests.

3.04 CONTRACTOR'S ATC MONITORING REQUIREMENTS

A. Provide support as needed to the CA in utilizing ATC and metering equipment to measure energy and water usage. Monitor, record, and trend log measurements.

END OF SECTION

SECTION 23 00 00
HVAC

(Filed Sub-Bid)

1.1 DESCRIPTION

A All of the Contract Documents, including General and Supplementary conditions and Division 0 – Bidding Documents, Contract Forms and Conditions of the Contract and Division 1 – General Requirements, apply to the work in this Section.

B Carefully examine all the Contract Documents for requirements which affect the work of this Section. The exact scope of this Section cannot be determined without a thorough review of all specifications sections and other Contract Documents.

C Where referred to, Standard Specifications, Recommendations of Technical Societies, and/or Manufacturer's Associations, plus Codes of Federal, State, and Local Agencies shall include all amendments current as of date of issue of these specifications.

1.2 REQUIREMENTS FOR SUBMITTING FILED SUB-BID

A. Sub-bids shall be submitted for the Work of this Section in accordance with the provisions of M.G.L. c.149 §§44A-J The time and place for submission of sub-bids are set forth in the **Advertisement.** The procedures and requirements for submitting sub-bids are set forth in the **Instructions to Bidders.**

B. Sub-bidders must be DCAMM Certified in the listed trade and shall include a Current DCAMM sub-bidder Certificate of Eligibility and a signed DCAMM Sub-bidder’s Update Statement with the bid

C. Specification requirements for the Filed Sub-bid "HVAC" include all of the following listed Specification Sections in their entirety.

SECTION 01 91 13 - GENERAL COMMISSIONING
SECTION 23 00 01 - HVAC
SECTION 23 08 00 - COMMISSIONING OF HVAC

D. The Work of this Section is shown on Drawings

TS-001, R-101, R-102, A-001, A-103, A-201, A-301, A-302, A-501, H-101, H-102, H-201, H-202, H-203, H-301, H-302, H-401, H-402

E. SUB-SUBS

1. Sub-sub bids are required for this Section. Sub-Bidders shall include the appropriate information for the list of sub sub-bid Class of Work noted below in this paragraph.

   Duct Insulation (Part of Section 23 00 00)
   Piping Insulation (Part of Section 23 00 00)
   Sheet Metal (Part of Section 23 00 00)
   Automatic Temperature Controls (Part of Section 23 00 00)
   Testing and Balancing (Part of Section 23 00 00)

2. If the Filed Sub-Bidder customarily performs the above Work with its own workforce, the Sub-Bidder should list its own name and trade and leave the dollar amount blank.

3. If the Filed Sub-Bidder does not customarily perform the Classes of Work with its own workforce, the Sub-Bidder should list the name of the contractor performing the work, the trade and insert a dollar amount.

END OF SECTION

SECTION 23 00 01

HVAC

(Part of Work of Section 23 00 00 – HVAC)

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. All of the Contract Documents, including General and Supplementary Conditions and Division 1, General Requirements, are hereby made a part of the work of this Section. Where paragraphs of this Section conflict with Division 1, the more stringent requirements shall govern.

B. All work shall comply with all federal, state and local codes and any other authorities having jurisdiction.

1.02 SUMMARY

A. Provide all materials, labor and equipment required to perform the work of this section, as shown on the Contract Drawings and as specified herein. Furnish and install the following including but not limited to:

1. Oil-fired boilers burners and accessories.
2. Flue piping, flashing and vent terminations
3. Roof mounted, sidewall and in-line exhaust fans.
4. Hydronic and electric Cabinet and Unit Heaters.
5. Louvers.
6. Air Cooled Condensing Unit.
7. Air to Water Heat Pump
8. Heat Exchanger
9. Thermal Storage Tank
10. Radiant tubing and accessories
11. Refrigerant piping and accessories.
12. Condensate drain piping.
13. Energy Recovery Ventilators.
14. Hot water coils.
15. CO/NO Detection System
16. Automatic controls.
17. Instruction manuals and startup instructions.
18. Equipment bases and supports.

19. Miscellaneous steel, dunnage, supports, hangers, pads, etc., as required.
20. All rigging and hoisting of equipment as required.

B. Related Work Specified Under Other Divisions

1. Division 26.00.00 - Electrical
2. Division 22.00.00 - Plumbing

C. This contractor is responsible for sleeving all holes required of his work prior to pouring of the concrete slabs. All holes less than or equal to 1-1/2" shall be the responsibility of this contractor to core. Sizes larger shall be cored by the G.C. However, if coring is required due to the failure of this contractor to set a sleeve prior to pouring than this contractor shall be responsible for bearing the cost of any of this additional coring work required of the G.C.

D. Where the specifications and/or plans conflict, the more stringent (costly) requirement shall control. Clarification from Engineer shall be obtained before proceeding.

1.03 SUBMITTALS

A. Submit in accordance with Section 01.33.00, SUBMITTALS.

1. Coordinated shop drawings, showing proposed layout of equipment, piping, ducts, registers, grilles, controls and other components of the system. Ductwork shop drawings shall be done at 1/4"=1'-0".
2. Control drawings showing all wiring, components, sequences of operation, etc..
3. Manufacturers catalogs, samples and other items needed to fully demonstrate the quality of the proposed materials and equipment.

B. Record Drawings

1. Include a copy of the Record/As-Built Drawings in each copy of the operation and maintenance manual described below. As-Built drawings shall reflect sizes and locations of all HVAC ductwork, piping, equipment and air terminals. Provide a CD of the record drawings in ACAD and PDF format and include one copy in each of the project manuals.

C. Testing and Balancing Reports:

1. Submit three (3) copies of a certified testing and balancing report to the Engineer for review and approval. Include all air flow and temperature readings as outlined herein.

D. Operating Instructions:

1. Prior to the completion of all work and the final inspection of the installation by the owner, three (3) copies of a complete Instruction Manual, bound in booklet form and suitably indexed, shall be submitted to the Architect for review and approval. All written material contained in the manual shall be typewritten or printed. Provide a CD of the O&M manuals in PDF format and include one copy in each of the project manuals.

1.04 INSTRUCTION OF OWNER'S PERSONNEL

A. After completion of all work and all tests and at such time as designated by the owner, provide the necessary skilled personnel to operate the entire installation for a period of twenty-four (24) hours. Training shall be broken up into multiple 4-hour sessions at a schedule acceptable to the Owner.

B. During the operating period, fully instruct the owner's representative in the complete operation, adjustment and maintenance of the entire installation.

1.05 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. The Contractor's superintendent shall conduct all coordination between the Contractor, Engineers, etc., and shall fully represent the Contractor's position in his absence. All decisions by the superintendent shall become the responsibility of the Contractor and binding to the Contract. The Contractor shall be responsible for the drawings, and that which is written or implied in the specifications.

C. Without additional cost to the Owner, provide such other labor and materials as are required to complete the work of this Section in accordance with the requirements of governmental agencies having jurisdiction, regardless of whether such materials and associated labor are called for elsewhere in these Contract Documents.

D. Before submitting the final proposal examine the site of the proposed work to determine existing conditions that may effect the work, as this section will be help responsible for any assumption in regard thereto.

1.06 GUARANTEE

A. The Contractor shall guarantee every component part of each system for a minimum of one year parts and labor. The contractor shall also provide the Owner with factory warranties for all equipment. For equipment with compressors such as air to water heat pump and air cooled heat pumps and condensers provide extended five year warranty on compressors. VRF equipment may have longer compressor warranties from the manufacturer of 7 to 10-years of which shall apply.

PART 2 – PRODUCTS

2.01 DUCTWORK

A. All duct runs shall be checked for clearances before installation of any ductwork. Above hung ceilings, duct locations, and elevations must be coordinated with work of other trades to avoid conflicts with structure, piping, conduit, light fixtures, and cable trays.

B. All sheet metal ducts shall be constructed of galvanized iron sheet of bend forming quality. The following specialty ducts shall be used:
   1. Ducts forming exterior louvers plenums shall be fabricated from aluminum.
   2. Exhaust ducts serving wet areas such as shower rooms and locker rooms shall be fabricated out of aluminum.

C. Duct construction shall be in accordance with best practices and latest SMACNA requirements for metal gauges, joints, reinforcing, and supports. Ductwork within 20 feet of a rooftop unit (RTU) supply and return or exhaust fan shall be minimum 16 gauge or 2 gauges heavier than SMACNA standard, whichever is greater (heavier gauge), to reduce breakout noise. All ductwork shall be rated for a minimum pressure classification of 3”w.g. upstream of VAV terminals and 2” elsewhere or higher rating as recommended by SMACNA standards. All exposed ductwork shall be constructed and hung to provide a neat, smooth, finished appearance. Cadmium plated sheet metal screws shall be used on all exposed ductwork. Ducts shall be free from expansion or contraction noises or rattling when fans are turned on or off.

D. Round ductwork shall be spiral formed galvanized steel of standard gauge as manufactured by United Sheet Metal, Spiramatic, Semco, or equal. Refer to Articles on Spiral Round and Double Wall Spiral Round for additional information.

E. Duct sizes change in shape or dimensions and offset as required to clear structural members and to coordinate with other trades. All changes must maintain the same friction loss as the original duct (i.e. similar free area) and must meet the latest ASHRAE and SMACNA standards.

F. The centerline radius of all duct elbows where shown on Drawings shall be at least one and one-half the width of the duct. Where building conditions do not allow for this radius, provide double wall airfoil turning vanes or, if in a sound attenuated duct, provide Sonotru Acoustical attenuating turns as manufactured by South Control Products Company or approved equal.

G. Duct sections 1 ft. 6 in. wide or less shall be butted together and jointed with flat drive cleats 2-1/8 in. wide. Top and bottom cleats shall be cut flush with duct and side cleats bent over to make a tight joint. Standing bar slips as specified for ducts over 18 in. may be used at the HVAC Subcontractor's option.

H. Ducts from 18 in. to 30 in. wide shall be jointed with 1/8 in. standing bar slips made of metal the same as or heavier than duct sheets. Joints in ducts with either dimension over 30 in. shall have 1 in. standing bar slips on those sides over 30 in. Where sides are over 42 in., the standing bar slips will be reinforced with 1-1/2 in. by 1-1/2 in. by 1/8 in. angles. Additional angle stiffeners not over 60 in. apart shall be provided between joints. Ducts over 60 in. in width shall be jointed with 1-1/2 in. by 1/8 in. angle irons riveted to ductwork on all sides with 1/8 in. rivets at not more than 4-1/2 in. on centers, sections bolted with 3/16 in. stove bolts at not over 6 in. centers, sheets turned over angles into joint at least 1/4 in.

I. Sheet metal screws 3/4 in. No. 10 may be used to attach stiffener angles to ductwork to secure seams, spaced not over 12 in. on centers and not less than two (2) per side of 12 in. or more, except where specified otherwise. Button punching shall not be used, except for pre-erection attachment of fittings.

J. Provide hinged galvanized steel access and inspection doors opposite each manual damper, at each fire damper, and at every duct mounted control device. Doors shall be of rigid construction with cast type rotary latches. Where space limitations do not allow full swing of the access door, two (2) rotary type latches shall be used. Doors located in insulated ducts shall be furnished with extended frames to serve as a stop for insulation. Insulate doors located in insulated ductwork. All doors shall be gasketed. Door shall be 10 in. by 12 in. minimum except where limited by duct width and shall be larger where necessary for access to fire damper fusible links or other devices.

K. Hangers for all rectangular ducts 4 sq. ft. in area or above shall be round bar type fastened to 1-1/4 in. by 1-1/4 in. by 1/8 in. angles under the ducts.
   1. Ducts less than 4 sq. ft. in area shall be hung with black 1 in. by l/8 in. strap iron bent 1 in. under bottom side of the duct and fastened to the duct with sheet metal screws, using not less than two (2) screws per side and as many more so that they are not greater than 6 in. centers.

L. Supports for round and oval ductwork shall be 1 in. by 1/8 in. black strap iron rolled to the perimeter of the duct with ends bent on top of duct and bolted. Hangers at supply diffusers shall be similar but separated at bottom and riveted to ductwork as required for adequate support.

M. Hangers for the round ductwork shall be 1 in. by 1/8 in. black strap iron bolted to supports and lagged into the ceiling construction. Hangers over 24 in. long shall be 3/8 in. rod type with bolted and threaded ends and angle bracket at ceiling.

N. Hangers are to be placed on not greater than 8 ft. 0 in. centers or closer where required so that the ductwork can support the weight of a 200 pound man at any point.

O. Wherever sound insulation lining is called for, the sheet metal duct size shown on the Drawings must be increased to provide the clear inside dimensions or cross sectional area shown on the Drawings. Dimensions shown on the drawings are clear inside.

P. Duct joint sealing, reinforcing, flanges, etc. for square sheet metal ducts shall be based on maintaining airtight ducts at 3 in. w.g upstream of VAV terminals and 2 in. w.g. elsewhere maximum static pressure with maximum of 5 percent leakage of total fan capacity, 1/2 of one percent for round and oval ducts. All joints in round and rectangular ductwork shall be sealed with UL classified NFPA approved duct sealer. Seal all ductwork at joists and seams with water based duct sealer DuctMate® EZ-Seal or approved equal.

Q. Upon completion of construction and before testing, the interior of all plenums shall be vacuum cleaned. When unit is first turned on, open duct access doors and blow out all foreign matter. Do not run fan without filter.

R. Fire Dampers
   1. Construction: UL listed and rated for 1 - 1/2-hour fire rating in conformance with NFPA 90A and authorities having jurisdiction. All shall be out-of-air stream type dynamic rated.
   2. Provide fire dampers with access doors where indicated on the plans and in openings in the following locations:
      a. Fire rated wall and fire partition.
      b. Fire rated ceilings and floors.
      c. When required by local and state codes.

S. At branch ducts, provide manually operated dampers of the type and arrangement shown on the Drawings, two gages heavier that the duct in which installed and equipped with locking quadrants. All branch take-offs shall be made with 45° or full Bellmouth type fittings. Spin-in and stick-on take-offs shall not be allowed.

T. Volume dampers, provide single and multi blade manually adjustable dampers as shown on drawings in all duct splits and branch connection of supply and exhaust air systems.

U. Flexible duct shall be 2" thick insulated low-pressure type with foil vapor barrier as manufactured by Automation Industries, Thermaflex type MKE or equal with a minimum installed R value of 8. Maximum length of flex duct is 5 feet. Secure with tie straps and seal with duct tape. Flexible duct shall not be allowed in areas where the duct is not concealed by a ceiling.

V. Acoustic insulation: All supply, return, and exhaust air ducts as well as return air plenums shall be lined internally with 1.0 inch thick acoustical liner equal to Owens Corning QuietR® Type 300, k=0.23 at 75 degree F. mean temperature for rectangular ductwork and Owens Corning QuietZone® 1.0"thick spiral duct liner, k+0.23 at 75 degree F. mean temperature for spiral and round ductwork. Duct liner shall have a minimum R-6 insulating value. Liner shall extend for a minimum of 10 feet (or more if indicated on drawings) from all air moving equipment (ducted ERU's & fan coil units). Liner shall clipped and cemented to the inside of the duct or shaft. All seams and edges of liner shall be sealed to prevent fraying in the airstream. Liner shall have an acrylic polymer fiberglass reinforced facing with an antimicrobial coating. Liner shall conform to NFPA and U.L. and ASTM C 1071 and C 1104 requirements and have a 25/50 flame/smoke rating. Locker room exhaust is exempt from the internal lining requirement.

W. Provide seismic bracing as required by the Commonwealth of Massachusetts building code 780 CMR, 9th edition. Contractor shall hire a seismic consultant to comply with requirements of the code. All equipment and ductwork shall be seismically supported and all piping over 2" unless specifically exempt by the building code.

2.02 SPIRAL DUCTWORK

A. GENERAL

All round and/or flat oval spiral duct and fittings shall be manufactured by a company whose has been in the business of manufacture of ductwork and spiral duct and fittings for at least ten (10) years. All spiral duct and fittings shall be manufactured by

the same firm and shall be as shown on the contract drawings. Acceptable manufactures shall be SEMCO Incorporated or approved equal sheetmetal fabricator.

All spiral duct and fittings shall be manufactured from G-60 galvanized steel meeting ASTM A924 and A653 requirements. Corrugations between spiral seams on all exposed applications shall not be accepted.

B. CONSTRUCTION

Branch connections shall be made with 90° conical and 45° straight taps as shown on the drawings. All branch connections shall be made as a separate fitting. Factory or field installation of taps into spiral duct shall not be allowed without written approval of the engineer. Manufacturer's published individual fitting performances shall be on file with the design engineer ten (10) days prior to bid.

90º and 45º elbows in diameters 3" round through 10" round shall be stamped or pleated elbows. All other elbows shall be of the gored type, fabricated in accordance with the following:

	Centerline Radius	Elbows less than 30°	Elbows 37° thru 71°	Elbows 72° thru 90°
Up to 1000 fpm	1.0 x diameter	2 gores	2 gores	3 gores
1001 to 1500 fpm	1.0 x diameter	2 gores	3 gores	4 gores
Above 1500 fpm	1.5 x diameter	2 gores	3 gores	5 gores

Where it is necessary to use two-piece mitered elbows, they shall have a minimum number of vanes in accordance with the following:

Duct Diameter	Number of Vanes
3" thru 9"	2
10" thru 20"	3
21" and up	5

Circumferential and longitudinal seams of all fittings shall be a continuous weld or spot welded and sealed with mastic. All welds shall be painted to prevent corrosion.

All field joints for round ducts up to and including 36" diameter and oval ducts up to and including 41” major axis shall be made with a 2" slip-fit or slip coupling. Diameters 38" round and larger shall be provided with AccuFlange, or equal, flanged

connections. AccuFlange, or equal, flanged connections may also be used in lieu of slip connections on smaller sizes.

Access doors shall be supplied by the duct manufacturer at all fire and/or smoke dampers.

All flanges and access doors shall be factory installed. Shipments of loose flanges, access doors, or taps for field installation into spiral duct will not be allowed.

C. METAL GAUGES

Metal gauges for single wall round ducts shall be as follows:

1. Round Ducts with Maximum 2" W.G. Positive Static Pressure. For 3” w.g. increase all gauges listed 1 gauge heavier. Ducts within 20 feet of air handler and RTU supply, return and exhaust fans shall be minimum 10 gauge to reduce breakout noise.

DUCT DIAMETER	SPIRAL DUCT	FITTINGS AND LONGITUDINAL SEAM DUCT
3" thru 26"	26	24
28" thru 36"	24	22
38" thru 50"	22	20
52" thru 60"	20	18
62" thru 78"	18	16

2. Round Ducts with Maximum -2" W.G. Negative Static Pressure. For 3” w.g. increase all gauges listed 1 gauge heavier.

DUCT DIAMETER	SPIRAL DUCT	FITTINGS AND LONGITUDINAL SEAM DUCT
3" thru 17"	26	24
18" thru 20"	24	22
21" thru 22"	24	20
24" thru 26"	22	20
28" thru 30"	22	18
32" thru 34"	20	18
36" thru 42"	20	16
44" thru 48"	20	18 (Note 1 & 3)
50" thru 60"	18	18 (Note 2 & 3)

Notes:

1. Reinforce with 1" x 1" x $^{1}/_{8}$" girth rings every 6 ft.
2. Reinforce with 1¼" x 1¼" x $^{3}/_{16}$" girth rings every 4 ft.
3. When companion flange joints are used as reinforcement,
   44" to 48" diameter shall be 2" x 2" x $^{3}/_{16}$"
   50" to 60" diameter shall be 2½ x 2½ x $^{3}/_{16}$"

2.03 AIR INLETS/OUTLETS

A. Diffusers, registers and grilles shall be installed where shown on the drawings and shall be of the type, sizes and quantities as indicated on drawings. Manufacturers shall be Titus, Krueger or MetalAire. On return grilles/registers, a sound line plenum box the full duct dimension of the grille/register shall be provided for connection to the branch duct. If entering a return plenum, plenum box shall be lined elbow. For square neck supply diffusers connecting to a round duct, the transition piece shall have a minimum 45 deg. angle.

B. Final color selection of all diffusers registers and grilles shall be by Architect. Submit color chart for review and selection.

C. Linear slot diffusers shall be constructed of solid extruded aluminum and discharge air in vertical throw pattern for ceiling applications and horizontal throw pattern for wall applications. The frames can be installed with a visibility flange or installed in standard drywall with concealed frame. Adjustable pattern controllers shall be provided for a variable aperture to adjust performance. Linear slot diffusers shall have engineered plenums by the same manufacturer as the unit. For supply air applications, the plenums shall be insulated.

2.04 PIPE & FITTINGS

A. All pipes shall be new, free from scale or rust, of the material and weight specified under the various services. Each length of pipe shall be properly marked at the mill or proper identification with name or symbol of manufacturer.

B. All steel piping, except where otherwise rated, shall be standard or extra strong weight, in conformance with ASTM A-53 Grade A seamless, as manufactured by National Tube Division, Republic Steel Corp., or approved equal.

C. All copper tubing shall be of weight as required for service specified, with conformance with ASTM B-88 for types “L” and “K” tubing, as manufactured by Chase, Anaconda, Revere or approved equal. Tubing and fittings shall be thoroughly cleaned with sand cloth and treated with an approved non-corrosive flux before solder is applied.

D. All refrigerant piping, liquid, and suction shall be type "ACR" copper tube, hard drawn, shipped to job site with end caps in place. Fittings shall be refrigerant grade copper fittings. Pipe and fittings shall conform to ANSI B31.5 and ANSI B9.1. Piping shall be complete with all refrigerant specialties, of line size, as indicated on the Drawings, and as required by installation requirements. Joints shall be silver soldered or brazed. All refrigerant piping shall comply with the requirements of the current International Mechanical Code.
   1. REFRIGERANT PIPING ACCESSORIES
      a. Provide all refrigerant piping specialties with a maximum working pressure of full vacuum to 450 psig and a maximum working temperature of 225 deg F. For systems using R-410A, provide all refrigerant piping specialties with a maximum working pressure of full vacuum to 800 psig and a maximum working temperature of 225 deg F.
      b. Flexible pipe connectors: Double braided bronze hose flexible pipe connectors with brazed end connections, or Double braided stainless steel flexible pipe connectors with REFLOK end connections.
      c. Filter Dryers: For circuits 15 tons and over provide angle pattern filter dryers with replaceable core. For circuits below 15 tons provide straight pattern filter dryers without replaceable core.
      d. Sight glasses: Two piece brass construction with brazed end connections. Include color indicator for sensing moisture.
      e. Solenoid Valves: Two way normally closed with two piece brass body, full port, stainless steel plug, stainless steel spring, teflon diaphragm and solder end connections. Provide replaceable coil assembly.
      f. Hot Gas Bypass Valves: Provide with integral solenoid valve, external equalizer connection and adjustable pilot assembly.
      g. Thermostatic Expansion Valves: Brass body, bronze disc, neoprene seat, bronze bonnet, stainless steel spring and solder end connections.
      h. Charging Valves: Provide ¼" SAE brass male flare access ports with finger tight, quick seal caps. Provide 2-inch long copper extension sections.
      i. Check valves: Spring loaded type with bronze body, bronze disc, neoprene seat, bronze bonnet, stainless steel spring and solder end connections.

E. Generally, unless otherwise specified, joints in steel piping 2-1/2" and under shall be screwed, and all sizes 3" and over shall be welded or flanged. Grooved mechanical joint pipe, fittings and couplings shall be allowed as an acceptable substitution for welded pipe fittings except as otherwise not allowed by applicable codes. Product shall be as manufactured by Victaulic Company of America, Grinnell Mechanical Products or approved equal. Fittings shall comply ASTM A106 with grooves or shoulders to accept grooved end couplings. Mechanical couplings shall consist of ductile or malleable iron housing, synthetic rubber gasket of a central cavity pressure-responsive design, nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.

F. Screwed Piping

1. All connections to apparatus with screwed piping shall be made with 250-pound brass or bronze seat unions.
2. All screwed nipples shall be scheduled 80 nipples.

G. Grooved mechanical joint pipe, fittings and couplings shall be allowed as an acceptable substitution for welded, threaded or flanged pipe fittings except as otherwise not allowed by applicable codes. Product shall be as manufactured by Victaulic Company of America, Grinnell Mechanical Products, Anvil International Gruvlok or an Engineer approved equal. Fittings shall comply ASTM A536 with grooves or shoulders to accept grooved end couplings. Mechanical couplings shall consist of ductile iron housing, synthetic rubber gasket of a central cavity pressure-responsive design, nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.

1. Rigid type: Housings (12" and smaller) shall be cast with offsetting, angle-pattern bolt pads or tongue and groove design to provide system rigidity and support and hanging in accordance with ASME B31.1 and B31.9..Only designs that require metal-to-metal pad contact permitted. Designs that permit spaces or gaps at bolt pads or require a torque as a primary means of ensuring joint rigidity per written manfuacturer's instructions not permitted. Victaulic Style 107H, Style 07 or W07 or Gruvlok Style 7401, Style 7402, Style 7400.
2. Flexible Type: Use in locations where vibration attenuation and stress relief are required. Victaulic Style 177, 77 and W77 or Anvil International Gruvlok Style 7001.. Three (3) flexible couplings may be used in lieu of each flexible connector at major equipment in accordance with published guidelines.
3. Flange Adapters: Ductile iron housing, flat face, for use with grooved end pipe and fittings, for mating directly with ANSI Class 125, 150, and 300 flanges. Victaulic Style 741, W741 or 743 or Anvil International Gruvlok Style 7012, 7013 or 7788.

H. Copper Hydronic Pipe Mechanical Fittings by Viega ProPress or approved equal by Elkhart or Nibco: Bronze or copper shall conform to the material requirements of ASME B16.18 or ASME B16.22, and the performance requirements of IAPMO PS117, and ICC LC1002. ProPress fittings ½-inch thru 4-inch for use with ASTM B88 copper tube type K, L, or M and ½-inch up to include 1-1/4-inch annealed copper tube. ProPress fittings shall have an EPDM sealing element and Smart Connect (SC) feature. 2-1/2-inch thru 4-inch shall have a 420 stainless steel grip ring, PBT separator ring, EPDM sealing element and Smart Connect (SC) feature. Sealing elements shall be verified for the intended use

ProPress bronze, or copper fittings: Pipe ends shall be cut on a right angle (square) to the pipe. Pipe ends shall be reamed and chamfered, all grease, oil or dirt shall be

removed from the pipe end with a clean rag. Visually examine the fitting sealing element to insure there is no damage, and it is properly seated into the fitting. Insert pipe fully into the fitting. Make a mark with a felt tip pen on the pipe at the face of the fitting. Always examine the tube to insure it is fully inserted into the fitting prior to pressing the joint. ProPress fittings ½-inch thru 4-inch shall be joined using Ridgid ProPress Tools. 2-1/2-inch thru 4-inch ProPress copper fittings shall utilize Ridgid ProPress XLC Rings, and 2-1/2-inch thru 4-inch bronze ProPress fittings shall utilize Ridgid ProPress XL Rings. ProPress fittings shall be installed according to the most current edition of the Viega installation guidelines. Sealing elements shall be verified for the intended use. Installers shall attend a Viega ProPress installation training class.

After ProPress fittings have been installed a "step test" shall be followed. Utilizing air, water, or dry nitrogen, pressurize the system not to exceed 85 psi. Walk the system and check for leaks. If you do not locate any leaks proceed to pressurize the system to the recommended pressures, not to exceed 600 psi. Should you locate a leaking joint that has not been pressed, relieve the pressure from the system, ensure the tube is fully inserted into the fitting and press the fitting. Resume test procedure, after the necessary repairs have been made. This test shall be in addition to the required hydrostatic tests specified elsewhere within the specification. (Add. #5)

I. Steel Hydronic Pipe Mechanical Fittings by Viega MegaPress or approved equal via welded, threaded or grooved piping system method: ½-inch through 2-inch shall conform to ASME B31.1, ASME B31.3, or ASME B31.9 MegaPress fittings with zinc and nickel coating for use with IPS carbon steel pipe conforming to ASTM A53, ASTM A106, ASTM A135, or ASTM A795. MegaPress fittings shall have an EPDM sealing element, 420 stainless steel grip ring, separator ring, and an un-pressed fitting leak identification feature. Sealing elements shall be verified for the intended use. Installation must be in accordance to manufacturer's instructions and specifications

Mega Press Systems: Pipe ends shall be cut on a right angle (square) to the pipe. Pipe ends shall be reamed chamfered and all paint, laqaur, grease, oil or dirt shall be removed from the pipe end with an abrasive cloth or Viega pipe end prep tool. Visually examine the fitting sealing element to insure there is no damage, and it is properly seated into the fitting. Insert pipe fully into the fitting. Make a mark with a felt tip pen on the pipe at the face of the fitting. Always examine the pipe to insure it is fully inserted into the fitting prior to pressing the joint. MegaPress fittings hall be joined using Ridgid MegaPress Tools. MegaPress fittings shall be installed according to the most current edition of the Viega installation guidelines. Sealing elements shall be verified for the intended use. Installers shall attend a Viega MegaPress installation training class.

2.05 PIPE FOR VARIOUS SERVICES

A. Solder for each solder-type fitting shall be of 95% tin and 5% antimony.

B. Pipe Schedule

Service	Piping Type	Piping Sch. WT.	Notes
Hot Water Piping	Copper Steel	Type 'L' Sch. 40	2-1/2" or less all sizes
Fuel Oil Piping	Steel Copper	Sch 40 Type K	all sizes ½" and under
Cond. Drain Line	Copper	Type 'L'	
Water Feed Line	Copper	Type 'L'	
Refrigerant Piping	Copper	Type 'K'	ACR hard drawn*

* Provide liquid line filter drier and sight glass for each circuit.

2.06 INSULATION

A. General

1. Provide materials complying with NFPA Bulletin 90-A, as determined by UL method NFPA 225-ASTM E 84, and complying with the governing code, with flame spread rating under 25 and smoke developed rating under 50.
2. Where vapor barriers are used, provide intact and continuous throughout.
3. Acceptable manufacturers:
   - Owes/Corning Fiberglass
   - Manville
   - Certainteed
   - Knauf

B. Supply, Return & Relief Air Ductwork

1. The following ductwork shall be insulated:
   - All supply air, return air and mixed air ductwork shall be insulated. Return air ductwork located above first floor ceiling, where a conditioned area is located above need not be insulated. All ductwork in attic space must be insulated.

- Relief and exhaust air ductwork from the discharge point to the backdraft or isolation damper (see outdoor air ductwork).
- All supply air duct and exhaust air ductwork connecting to an energy recovery unit. This includes recovery unit exhaust air ductwork from the unit to the building envelope discharge point.

2. Above ductwork shall be insulated with 2.2 inch thick flexible blanket duct insulation with vapor barrier, 0.75 lbs. per cu. ft. density glass fiber with maximum K factor of 0.27 at 75 degree F. mean temperature with fire retardant foil/Kraft (FSK) vapor barrier facing. Product shall be Johns Manville Microlite® FSK Type 75 or equal. Minimum installed R value shall be 6.0. All seams and joints shall be taped with matching kraft paper vapor barrier tape. Exposed supply and return ductwork located within the conditioned space its serves need not be insulated. To achieve R-values above internal lined ductwork may still require added external insulation as specified herein.

C. Outdoor Air Ductwork

1. All outdoor air ductwork including combustion air ductwork and outdoor and relief/exhaust air louver plenums shall be insulated with 4.3 inch thick flexible blanket duct insulation with vapor barrier, 0.75 lbs. per ft. density glass fiber with maximum K factor of 0.27 at 75 degree F mean temperature with fire retardant foil/Kraft (FSK) vapor barrier facing. Minimum installed R-value shall be 12. Ductwork within mechanical rooms shall be rigid type insulation. Product shall be Johns Manville Microlite® FSK Type 75 or equal. All seams and joints shall be taped with matching kraft paper vapor barrier tape.

D. Piping Insulation

1. All hot water piping (supply and return) shall be insulated with the thickness of insulation as follows:

   Boiler Piping (high temp above 140F) 2” thick for pipes up to 1.25” diameter, 1.5” for pipes over 1.25” nominal pipe diameter.

   Heating Piping (under 140F): 1” for pipes up to 1.25” diameter, 1.5” for pipes over 1.25” nominal pipe diameter.

   Hot water piping insulation shall be equivalent to Owens Corning Fiberglas™ with Evolution™ Paper Free all service jacket. All condensate piping and domestic water feed lines to the hydronic system shall be insulated with minimum ½” thick pipe insulation similar to that specified above. Provide Zeston or equal polymer fittings at all elbows and fittings. Seal all joints and seams vapor tight. For piping 2” or greater in size provide high-density crush resistant (calcium silicate blocking or equal) insulation at all hangers. Provide 14 gauge 18” insulation shields at every hanger. Vapor barrier must be maintained continuously on all piping.

2. Refrigerant vapor (suction, hot gas and evaporating liquid) piping shall be insulated with 1" thick closed cell pipe insulation as manufactured by Armacell or approved equal with seams and joints cemented vapor tight. Product shall be similar to Armaflex Tuffcoat with water proof & UV resistant exterior coating.

3. Provide covering on all exterior insulated hydronic piping. Product shall be field-applied or pre-applied protective finishing and/or vapor sealing, operating within the range of -94°F (-70°C) and 300°F (149°C), jacketed with laminated, flexible, self-adhering, protective jacketing, vapor barrier and weather proofing membrane, having a high performance acrylic adhesive capable of installation with no additional mechanical attachment. Material is to be VentureClad 1577CW (5ply) Natural, White (White Membrane "WM"), or approved equal finish selected based on availability and desired final appearance of insulated system. Jacketing material is to have a maximum flame spread/smoke developed index of 10/20 per UL 723 test, a .000 water vapor permeance rating per ASTM E-96, and mold inhibitors incorporated. All products are UV stable. Fabrication and installation shall conform to the manufacturer's installation instructions and Midwest Insulation Contractors Association National Insulation Standards Manual. If there is conflicting information, manufacturer's installation instructions are to be followed.

E. Refer to Ductwork Article for internal acoustical insulation.

2.07 HANGERS AND SUPPORTS

A. Provide seismic bracing as required by the Commonwealth of Massachusetts building code 780 CMR, 9th edition. Contractor shall hire a seismic consultant to comply with requirements of the code. All equipment and ductwork shall be seismically supported and all piping over 2" unless specifically exempt by 780 CMR (reference IBC 2009 in accordance with ASCE 7-05, chapter 13, section 13.1.4.2 doe Seismic Design Category B). See articles on vibration and seismic control.

All horizontal piping shall be supported for its entire length. Suspended piping shall have hangers located within 2 ft. 0 in. of elbows and spacing shall be reduced, where required, to support heavy groups of fittings and valves. Grinnell Figure numbers are used to establish the desired style and quality. Other equal manufacturer, as approved by the Architect-Engineer, will be acceptable. All hangers shall be UL or FM approved for the application and use.

B. Maximum spacing of hangers and supports shall be as follows:

1. Steel Pipe: 1-1/2 in. and smaller - 6 ft. 0 in.

2. Steel Pipe: 2 in. to 8 in. - 8 ft. 0 in.

3. Copper Tube: 1-1/4 in. and smaller - 5 ft. 0 in.

4. Copper Tube: 1-1/2 in. and larger - 8 ft. 0 in.

C. Pipe attachments shall be as follows:

1. All piping up to 2 in. diameter shall be supported using pipe rings or bands.

2. All systems 2-1/2 in. to 6 in. pipe sizes and insulated pipe 1-1/2 in. and smaller - Grinnell Figure 260 adjustable clevis type.

3. All systems, bare or insulated pipe 6 in. and larger - Grinnell Figure 174 or 181 adjustable swivel roll type.

4. All systems, where overhead space is limited and pipes are close to underside of beams or slabs - Grinnell Figure 171 double rod roll hanger. Pipe installed on rack supports shall be supported on pipe roll chairs or stands equal to Grinnell Figure 175 or Figure 271.

5. All vertical drops of pipe 2-1/2 in. and larger shall be supported from the floor, including all pump suction and discharge piping.

6. Pipe attachments in metal to metal contact with copper and brass pipe shall be copper plated or PVC coated.

7. On all insulated pipes, provide attachments sized for outside diameter of insulation to permit insulation to pass through hanger. Include pipe covering protection shields at all hangers.

D. Supporting rods for hangers shall be adjustable, threaded with locknuts sized as follows:

1. Pipe: 2 in. and smaller - 3/8 in.
   2-1/2 in. to 3-1/2 in. - 1/2 in.
   4 in. and 5 in. - 5/8 in.
   6 in. - 3/4 in.
   8 in. to 12 in. - 7/8 in.

2. Where double rod hangers are used, the rod size may be reduced one (1) size below the above sizes.

E. Hanger rods shall be secured to building by one of the following approved structural attachments:

1. To concrete structure - use inserts, Grinnell Figure 28, galvanized steel. Where additional supports are needed after concrete work is completed or where required in solid masonry, use self-drilling inserts equal to Phillips "Red Head" or expansion shields equal to Grinnell Figure 117. Cadmium plated piping 10 in. and larger is to be supported from wall, floor, or steel structure.

2. To overhead steel deck - use Grinnell Figure 209 toggle bolt with washers and Figure 209 rod coupling; or weld rod to 1/4 in. thick by 4 in. by 4 in. fish plate laid across top of steel deck; or bolt and weld Grinnell Figure GS-l00H channels not less than 12 in. long to underside of steel deck at right angle to ribs and attach hanger rods with GS-40 nuts.

3. To structural steel beams for pipes 2-1/2 in. to 5 in. - by beam clamps, Grinnell Figure 229, 265, or 267; 6 in. to 10 in. by bolted and welded beam attachments - Grinnell Figure 66 or 252. For pipes 2 in. and smaller, use malleable iron C-type beam clamps with retaining clip, Grinnell Figure 87; all piping is to be hung from the top chord of all steel joists. All piping 4 in. and larger shall be supported from 2 in. angle iron spanning between two (2) joists to spread loading. For joists, pipes and/or supplemental support steel must be attached to top of joist at panel points.

F. Pipes running along walls or close to floor shall be supported as follows:

1. Piping along walls may have hanger rods supported from welded steel brackets, Grinnell Figure 195, or in lieu of the above, for 4 in. and larger, may rest on adjustable roll stands supported by welded channel or I-beam wall brackets.

2. 2 in. and smaller - supported from floor on legs of angle iron, channels, or pipe legs.

3. 2-1/2 in. to 4 in. - adjustable pipe saddles, Grinnell Figure 264, supported from floor to pipe legs.

4. 4 in. and larger - pipe roll and plate, Grinnell Figure 277 supported as masonry piers and shimmed to provide proper pitch as required, or Grinnell Figure 276 adjustable pipe roll stands supported on masonry piers, welded steel channels, or I-beams.

G. Groups of horizontal pipe 3 in. and smaller, running at the same elevation, may be supported by means of vertical hangers and horizontal angles, channels, or "Unistrut" on which pipes shall rest and be held in alignment with suitable pipe clamps. Building attachments must be sized for total load of all pipes. Details of such hangers

must first be approved by the Architect-Engineer. No contact between dissimilar metal is permitted.

H. Equipment Supports:

1. All floor mounted machinery and equipment shall be installed on minimum 4 in. thick concrete housekeeping bases with top edge of base chamfered at a 45 degree angle. Bases will be provided under other Sections of these Specifications. Furnish scaled layouts of all required bases, with dimensions of bases, and location to column center lines. Furnish templates, anchor bolts, and accessories necessary for base construction.

2. Furnish and install all supplementary steel, channels, and supports required for the proper installation, mounting, and support of all equipment. Supplementary steel and channels shall be firmly connected to the building construction.

3. The type and size of the supporting channels and supplementary steel shall be of sufficient strength and size to allow only a minimum deflection in conformance with the manufacturer's requirements for loading.

4. All supplementary steel and channels shall be installed in a neat and workmanlike manner parallel at the walls, floor, and ceiling construction. All turns shall be made with 90 degree and 45 degree fittings, as required to suit the construction and installation conditions. Provide factory-fabricated tank saddles for tanks mounted on steel stands.

5. Where ceiling mounting is indicated or specified, use suspended platform or hangers, brackets, or shelf, whichever is most suitable for equipment and its location. Construct structural steel members, steel plates, rods, as required; brace and fasten to building structure or to inserts as approved.

I. Rooftop pipe support shall be similar to Portable Pipe Hangers item number PP10 w/roller. Base Material: Injection molded high impact polypropylene with UV-inhibitors and Antioxidants. Hardware: Nuts, Washers, Rod and Roller: Hot Dip Galvanized. Coordinate with roofer prior to installation."

2.08 PIPE SLEEVES AND ESCUTCHEONS

A. Standard IPS steel or wrought iron sleeves shall be provided wherever exposed pipes pass through masonry walls or partitions. Galvanized steel pipe sleeves shall be used on penetrations thru non masonry walls. Pipe sleeves are to be two (2) pipe sizes larger than line size. On insulated piping, sleeves shall be sized to allow insulation to pass through the sleeve without gouging. Within continuous vertical enclosed pipe

chases, sleeves through floors may be 24 gauge galvanized sheet steel in lieu of iron pipe.

B. Iron pipe sleeves shall be provided through "wet" floors (such as kitchens, toilets, janitor's closets) and shall be extended 1 in. above finished floors. Sheet metal screws may be used in other locations and shall be cut flush with floor. Pipe sleeves in walls shall be flush with face of wall both sides. Pipe sleeves through outside walls must be caulked watertight or installed with Eclipse flanged service entrance sets.

C. Provide escutcheons equal to Grinnell Figure 10 or Figure 13, chrome plated, at all locations (except inside unfinished mechanical equipment rooms and enclosed pipe chases) wherever exposed bare pipes 4 in. or smaller pass through walls, floors, or ceilings.

2.09 VALVES

A. All valves shall be of a design, which the manufacturer lists for service and shall be of the materials allowed by the latest edition of the ASME Code for pressure piping for the pressure and temperature contemplated, unless higher grade or quality is specified herein. All valves shall be of the same manufacturer except for special applications.

B. The system shall be supplied with valves in all branch mains and risers, at all pumps, tanks, reducing and control valves, heating and cooling surfaces and at all apparatus; so located, arranged and operated as to give complete shut-off. Except where flanged valves are used, each connection to equipment shall be made with screwed or flanged unions on the equipment side of the valves.

C. All valves 2” in diameter and smaller shall be bronze with bronze bodies. Valves 2-1/2” in diameter and over shall have iron bodies with bronze trim (except where otherwise noted).

D. Ball valves shall be full port bronze body, bronze or stainless steel ball and stem, Teflon seats and seals, threaded ends, 400 psig cold W.O.G. by Watts, Jenkins or equal.

E. All bronze and iron valves shall be furnished with Teflon impregnated packing.

F. Butterfly valves shall only be allowed on piping 3” and larger and shall be tight shut-off type with angle/worm gear handle mechanism with position marker.

G. Provide valves of the type as shown on the drawings as specified herein and as scheduled:

Service	Valve Type	Rating	Remarks

Water	Ball	400 W.O.G.	all sizes
Water Throttling	Globe	200	3” and larger
Water Shut-off & Throtl.	Butterfly	200	3” and larger
Drain Valves	Ball	200 W.O.G.	Hose end & cap

2.10 CENTRIFUGAL PUMP

A. Furnish and install where shown on the plans electric motor driven pumps as scheduled and specified. Pumps shall be in-line type as scheduled as manufactured by Grundfos, Taco or Bell & Gossett.

B. Pumps shall have capacities as scheduled on the drawings. Pumps shall be selected to operate at or near their point of peak efficiency thus allowing for operation at capacities of approximately 25% beyond design capacity. In addition, the design impellar diameter shall be selected so that the design capacity of each pump (GPM and TDH) shall not exceed 90% of the capacity obtainable with maximum impellar diameter at the design speed for that model or as approved.

C. Motors shall be ECM premium efficiency type capable of qualifying for a utility company rebate.

D. Where scheduled, pumps shall come with ECM motors. The pumps shall have the following features and benefits:
   1. Compact permanent magnet maintenance-free wet rotor technology
   2. Nut capture flanges.
   3. Integrated terminal box and field mounted disconnect switch
   4. Simple one button hydraulic selection
   5. Seven hydraulic selections available
      > Three fixed speeds options
      > Three constant pressure options
      > AUTO*ADAPT*
   6. Real time LED display:
      > Watts indicator
      > GPM flow estimation indicator
      > Hydraulic mode selection
   7. Metallurgical options:
      > Cast-iron
      > Stainless steel (only for potable water service)

8. Integrated check valve (when available based on pump size)

2.11 HYDRONIC UNIT & CABINET UNIT HEATERS

A. Provide hot water cabinet and unit heaters as manufactured by Sterling, Modine, Rittling, Vulcan Radiator or approved equal. Units shall be U.L. listed. Units shall have deflection blades configured to throw air towards the floor.

b. Cabinet unit heaters shall have a fully enclosed cabinet with adjustable frame for full, semi or surface mounting as required by the installation.

c. Provide baked enamel finish on unit. For cabinet unit heaters submit color selection chart for selection by Architect.

d. Furnish disconnect switch for all units. On cabinet unit heaters provide 3-speed fan speed control switch. Cabinet unit heaters shall have tamper proof fan speed switch enclosure.

2.12 SYSTEM WATER TREATMENT

A. Provide 5-gallon chemical bypass shot feeder equal to Neptune model #DBF-5HP with #FBK-5 filter bag kit and leg stands. Bag kit shall have stainless steel filter rack and 20-micron filter bag. Include three (3) spare bag replacements.

B. All systems shall be thoroughly flush with clear water and then filled with clear water and circulated for a period no less than 8 hours. Drain water, clean all strainers and then refill the hot water system with clean water and chemically treat.

C. This Contractor shall furnish a one-year system water treatment service by a qualified water treatment and testing agency, including all chemicals required to prevent scaling and corrosion and a minimum of four (4) site visits. Chemicals used shall be approved by the boiler manufacturer. As a minimum, site visits and water testing shall include: initial system fill/start-up, one (1) month after start-up, six (6) months after start-up, and one (1) year after start-up. Provide written report to Architect-Engineer detailing initial system fill/start up test results.

D. For the air to water heat pump Heat Exchanger loop once system is flushed, fill with 35% corrosion inhibited propylene glycol.

2.13 SPECIALTIES

A. See also valve and other sections for additional information.

B. Multi-Purpose Valve – At each pump, Taco model MPV (multi-purpose valve) combination non-slam check valve, globe balancing valve and shut-off valve with

calibrated pressure taps as manufactured by Taco or Bell & Gossett. Furnish calibrated meter to Owner upon completion of project. Note:

1. On ECM pumps and VFD pumps, this device shall be fixed in the 100% open position and is only intended to function as a physical balancing check element and non-slam check valve.
2. On smaller pumps 10 GPM and below, in lieu of MPV provide a circuit setter balancing valve, non-slam check valve and ball valve shut-off.

C. Swing Check – Bronze body, 125 W.S.P., 200 W.O.G.

D. Strainers – Strainers shall be iron body 'Y' type with stainless steel strainers, 250-psig steam and 400 W.O.G. Provide ball valve with hose bib for blow down similar to Watts # B-6000-CC.

E. Dielectric unions – Provide where joining to dissimilar metals, Watts series #3000 or approved equal.

F. Provide all fuel oil components and accessories for a fully code compliant and functional fuel oil system including but not limited to the following:
   1. Two (2) 330-gallon fuel oil tanks with legs, fill gauge and vent alarm. Tanks shall be UL listed made of 12 gauge carbon steel.
   2. Firematic thermally actuated automatic oil shut-off valves at each burner and each fuel oil tank.
   3. Oil Safety valve at each fuel oil tank.
   4. Tigerloop® oil deaerator at each burner (for 2-stage oil pumps)
   5. Fuel oil supply line from each tank to the burners.
   6. Fuel oil tank fill and vent lines with screened vents and fill ports matching oil delivery service fitting.
   7. Contractor shall arrange and pay for a minimum oil delivery of 100-gallons (50-gallons per tank) for use in test firing oil boiler plant. Refer to division 1 for additional requirements.

G. Air Separators – Provide Air Separators for the hot water no smaller than the pipe size or larger as shown on the drawings or to insure the peak flow rate is within the products maximum recommended flow rate. Unit shall be of a fully coalescing type.

   1. For system, HX and radiant loop air separators, provide Spriotherm Spirovent or approved equal microbubble separator complete with quick air release vent. On sizes allowing such, provide drain port with valve and hose bib.

   2. For boiler plant interface to building loop provide a decoupled header with tees spaced at no greater than 12" as well as a main system Spirotherm Spirovent air separator or, if shown on the drawings, provide a Spirotherm Spirovent boiler system decoupler provide a Spirovent Quad VDX series or equal air eliminator,

dirt separator, low less header/decoupler with quick air release and drain valve. Unit shall be of the following construction:

a. Separator shall be fabricated steel, rated for 150 psig working pressure, stamped and registered in accordance with ASME Section VIII, Division 1 for unfired pressure vessels.

b. Vessel shall include one chamber above the higher nozzle set for air elimination, one below the lower nozzle set for dirt separation, and one between the upper and lower nozzle sets for hydraulic separation. The vessel diameter, height above and below the nozzles, and distance between the nozzles must be equal to the basis of design.

c. Units shall include an internal medium bundle filling the entire vessel. The bundle shall consist of a copper core tube with continuous wound copper medium permanently affixed to the core.

d. Each separator shall have a separate venting chamber to prevent system contaminants from interrupting venting operation. The venting chamber shall employ an integral full port float actuated brass venting mechanism.

e. Air elimination performance shall be capable of removing 100% of the free air, 100% of the entrained air, and up to 99.6% of the dissolved air in the system fluid.

f. Dirt separation performance shall be capable of removing 80% of particles 30 micron and larger within 100 passes.

g. The warranty period shall be a non-prorated period of 36 months from date of purchase

G. Air Vents – Provide automatic air vents at all high points within the system and at all coils. Air vents shall be Sparco model #FV 147A. Vents shall be piped to nearest floor drain.

H. Water pressure reducing valves – Provide water pressure reducing valve for each water feed to the heating water systems. Valve shall be similar to Watts #U5 with strainer and pressure gauge.

I. Balancing Valves – Provide calibrated balancing valves where shown on the drawings and as specified herein, Taco model #ACUF circuit setters. Provide one at each location: 1) at each individual boiler return line; 2) at every water coil; 3) at every baseboard branch, unit heater and cabinet heater; 4) at each radiant heat injection loop. In addition, contractor shall furnish to the Owner a Differential Gauge meter Taco model #789 with durable carrying case and hose connections.

J. Expansion Compensators – Provide housed expansion compensators with associated pipe alignment guides and anchors where shown on the drawings or as required where line lengths exceed 100 feet. Compensators shall have double wall stainless steel bellows housed in carbon steel encloure. Provide Metraflex Joints or approved equal at building expansion joints and seismic separation joints within building where shown on plans. In other locations, compensators shall be by Senior Flexonics or approved equal.

K. Refer to System Water Treatment Article for shot feeders.

L. Provide an automatic glycol system feeder pump with 6-gallon tank for the air to water heat pump. Heat Exchanger loop system which shall maintain system pressure by pumping 35% propylene glycol into the system automatically as pressure dictates. For system provide Wessels Company #GMP-6 6-gallon mix tank, pump, piping, pressure controller, valves, etc… or approved equal.

2.14 RADIANT HEAT SYSTEM AND COMPONENTS & UNDERSLAB TUBING

A. Provide radiant heating system with products and configuration as shown on the drawings as manufactured by Viega, Wirsbo, Uponor or approved equal. The underslab piping and components in this section shall also apply to underslab tubing/piping shown on the plans convey heating hot water.

B. ViegaPEX™ Barrier Hydronic Radiant Heat Tubing
   1. This specification designates the requirements for ViegaPEX Barrier cross-linked polyethylene (PEX) tubing for use in hydronic radiant heating systems. ViegaPEX Barrier includes an oxygen barrier layer that helps restrict the passage of oxygen through the wall of the tubing. All ViegaPEX is manufactured and tested to the requirements of ASTM F876 and F877 and is CTS-OD (copper tube size outer dimension controlled) with an SDR – (standard dimension ratio) 9 wall thickness.
   2. ViegaPEX Barriet tubing producg is produced from cross-linkable, high density polyethylene resin. The cross-linkable resin is produced by grafting organo-silane molecules onto a base polyethylene chain. A catalyst that initiates the cross-linking process is blended with the resin before extrusion. Cross-linking is conducted after extrusion by exposing the tubing to heat and moisture (steam). ViegaPEX Barrier includes 4 layers. The first layer is the cross-linked, high density polyethylene. The second layer is an adhesive for the third layer, the ethylene vinyl alcohol layer (EVOH oxygen barrier). The fourth layer is another way then layer of polyethylene, put on the outside to protect the EVOH layer from damage. EVOH is highly resistant to the passage of oxygen.
   3. Tubing is marked with manufacturer, ViegaPEX Barrier, nominal size, rating, codes and standards, approvals, date, material code and location of production. Tubing is third party tested to the requirements of the stated ASTM standards.

Tubing includes incremental footage markings to assist with loop layout. ViegaPEX Barrier is certified to NSF 61 and 14 for use as part of, or connected to a potable water system.

4. ViegaPEX Barrier tubing is recommended for hydronic radiant heating, cooling and snow melting systems utilizing water or a water/glycol mix as the heat or cold transfer media. Tubing may be installed in concrete, gypsum based lightweight concrete, sand, asphalt (in accordance with special guidelines) in or under wood flooring or behind wallboard or plaster. ViegaPEX Barrier may also be used as transfer lines or baseboard heating systems with a maximum temperature of 200°F @ 80 psi.
5. Install ViegaPEX Barrier in accordance with installation manuals provided by manufacturer and applicable code requirements. Water or air can be used to pressure test the system. Please follow manufacturer's requirements on pressure and length of time.

C. Stainless Manifolds Shut Off/Balancing/Flow Meters
   1. Stainless manifold is to be used in closed loop hydronic heating systems. These preassembled 1-1/4" diameter stainless supply and return manifolds come attached to two 6-5/8" spacing brackets for compact remote mounting. This stainless manifold provides shut off and balancing valve with flow meters for each circuit. Each flow meter/balancing valve allows graduated flow setting up to 2 gpm. Maximum18 gpm per manifold. The air bleeder and purge valves are connected and factory tested. 1-1/4" union connectors, 1" NPT removable end caps. SVC Circuit connection fittings are sold separately.

D. Basic Heating Control
   1. The radiant heat control shall be by the EMS system. Refer to Automatic Temperature Controls for information on controls. Coordinate location of in-slab sensors prior to pouring of slabs.

E. 2-Way Modualting Injection Valves. Valves shall be provided and controlled by EMS in conjunction with the radiant heat control system to maintain both space and slab temperatures.

F. Entire radiant tubing system shall be installed per manufacturers instructions. In this application the tubing shall be attached to the slab reinforcing mesh with insulation provided under the complete slab. In areas where the tubing is running through areas outside the controlled space to get to the manifolds, the tubing shall be covered with insulation prior to the pouring of the slab. Insulation shall be flexible style to allow concrete to pour onto and around piping and avoid any voids forming within the slab.

2.15 EXHAUST FANS

A. Exhaust fans shall be of the type and capacity shown on the Drawings; Greenheck, Carnes, Penn or equal. Fans shall be tested in accordance with AMCA and bear the AMCA Certified Performance Ratings Seal; fans shall be UL Listed.

B. Centrifugal roof exhaust fans shall be heavy gauge aluminum mounted on a rigid support structure to provide minimal resistance to airflow and minimal noise generation. Fan wheel shall be of the aluminum backward curved centrifugal type belt driven. Motorized backdraft dampers shall be provided on each roof exhaust fan. Backdraft damper shall be interlocked with operation of exhaust fan to open fully, or modulate as specified, upon fan activation and close completely when fan is disabled. If dampers are not shown connected on the electrical plans, this Contractor shall hire the project electrician to wire the dampers to interlock with fan operation. Fans shall come with a factory wired and mounted disconnect switch.

C. Propeller fan shall be heavy gauge aluminum mounted on a rigid support wall housing structure to provide minimal resistance to airflow and minimal noise generation. Motorized backdraft dampers shall be provided on exhaust fan. Backdraft damper shall be interlocked with operation of exhaust fan to open fully upon fan activation and close completely when fan is disabled. If dampers are not shown connected on the electrical plans, this Contractor shall hire the project electrician to wire the dampers to interlock with fan operation. Fans shall come with a factory wired and mounted disconnect switch. This Contractor shall furnish all starters. Propeller fans shall have louvers furnished to match the fan size.

D. Vehicle exhaust utility blower fans shall be constructed of heavy gauge galvanized steel mounted on a rigid support structure. Fan blades shall be non-overloading backward incline type heavy gauge welded steel construction. Fans shall be belt drive type rated for high temperature vehicle exhaust use. Provide weather cover, vibration hangers, flexible high temperature inlet and outlet connector, backdraft damper. All components shall be factory painted with a baked enamel finish. Fan blade shall be spark resistant and motor shall be explosion proof. Provide high pressure class fan as manufactured by Greenheck, Ventaire, Monoxivent, Harvey or approved equal.

E. Ceiling exhaust fans shall be direct drive centrifugal type. Motor and fan shall be removable from housing; motor shall have ball bearings. Housings shall be steel with acoustic insulation; provide ceiling grille. Provide factory mounted disconnect switch and backdraft dampers. Provide hanging vibration isolators. For fans in emergency electrical rooms and elevator machine rooms provide 1-1/2 hour ceiling radiation fire damper at fan grille.

F. Duct mounted fans shall be of the centrifugal direct drive type. The fan housing shall be constructed of heavy gauge galvanized steel. The housing interior shall be lined with ½" acoustic insulation. The outlet duct collar shall include an aluminum back-draft damper and shall be adaptable for horizontal or vertical discharge. The access

for wiring shall be external. The motor disconnect shall be internal and of the plug in type.

1. The motor shall be mounted on vibration isolators. The fan wheel shall be of the backward inclined self cleaning type and dynamically balanced. All fans shall bear the AMCA Certified Ratings Seal for sound and air performance and shall be UL Listed. as manufactured by Greenheck, Schofield, Wisconsin, or approved equal

G. Sidewall propeller fans shall come complete with wall sleeve, OSHA motor guard and gravity or motorized backdraft damper as scheduled. In addition, provide matching wall louver. Refer to Louver section of this specification section for louver requirements

H. Motors over ½ HP in size shall be premium efficiency type.

I. All 3-phase fans shall be furnished with H-O-A combination style disconnect/motor starters. Starter for EF-1 shall be 2-speed style. Starters shall come with integral control transformer (as required) with coil voltage to be compatible with automatic control system (i.e. 24 volt or other). Furnish weatherproof disconnect switches for all roof fans. Electrical contractor to mount and power wire starters. Coordinate all locations with electrical contractor.

J. Fans shall be licensed to bear the AMCA Seal for sound and air performance.

K. Provide start/stop switch with green “ON” pilot light for vehicle exhaust fan and others fans as indicated in the equipment schedule or specified within the control section of this section.

2.16 HOT WATER BOILER

A. Provide wet based cast iron sectional type boilers of the size and type indicated on the drawings. Acceptable manufacturers shall be Weil-McLain, Smith, Peerless or approved equal. Specified boiler has a Thermal Efficiency of 84% or higher.

B. Boilers shall be, U.L. listed and bear an ASME stamp. Boilers shall come complete with cast-iron heat exchangers, insulated jackets, Carlin or Beckett flame retention #2 oil-fired fuel burners with 1-stage or recirculating 2-pipe fuel oil pumps, aquastat limit and pump controller, low water cut-off & manual reset high limit control, system pressure & temperature gauge and 50 psig relief valves. In addition barometric draft damper shall be provided for each boilers. For 2-stage burner fuel pumps, provide Tigerloop® oil deaerator at each burner at connection from one pipe oil supply to 2-pipe fuel oil burner pump.

C. Contractor is responsible for furnishing and installing all controls, wiring, etc.. to make the system fully operational. This shall include wiring of combustion air dampers, safeties, etc..

D. Boilers shall be UL listed and bear an ASME stamp.

E. Field Testing

1. After final assembly and connection, each Boiler shall be thoroughly cleaned internally following the manner described within the Boiler manufacturers installation instructions.
2. All field tests after the Boiler(s) have been installed and connected to the system shall be limited to not more than 80 PSI or as otherwise directed by the boiler manufacturer. Installing Contractor shall furnish all equipment, piping, labor, staging, fittings, valves, hoses and other materials and shall pay all required permits for Inspection as may be required to perform such tests as may be directed by these Contract Documents and as required by the Consulting Engineer and the State Boiler Inspector.
3. An initial Hydrostatic pressure test shall be conducted on each Boiler for a period of not less than 5 hours. Tests shall be of such duration as necessary and as directed by the Consulting Engineer to ensure that the Boilers have been installed and piped correctly with no leaks or other improper operating conditions.
4. Installing Contractor shall contact and notify the State Boiler Inspector when the installation of the Boiler(s), Burner(s) and controls is substantially complete. Installing Contractor shall request an inspection of the Boilers to be conducted by the State Boiler Inspector and to have a Certificate of Inspection issued upon satisfactory inspection.
5. After receipt of certificate of Inspection, Installing Contractor shall furnish a suitable glass front frame in which to place said certificate. Frame, with Inspection certificate inserted therein, shall then be placed on or posted in a suitable location within the Boiler room in which the new Boilers have been installed.
6. Installing Contractor shall maintain all apparatus in satisfactory operating condition. Perform periodic Burner tune-up and cleaning of the Boiler fireside surfaces when dirty, provide preventative maintenance, perform turndown tests, conduct tests for Flame Safeguard, Combustion Efficiency, Draft tests, Limit Control tests and Safety Valve tests, check the ignition system and adjust, repair or replace any as necessary while the heating system is under his ownership and control and until such time as the Owner accepts the equipment, issues the Final certificate of Payment and assumes the full obligation of Ownership.
7. Installing Contractor shall note that any Warranty Service (Hereinafter specified) as may be absorbed by the authorized Service representative shall in no way absolve the Installing Contractor from any and all responsibility for the Care, Service and Preventative Maintenance for Materials furnished to this Contract,

while the Heating System is under his Control, and until final acceptance by the Owner.

Q. Commissioning

1. An authorized representative of the Boiler or Burner manufacturer shall perform the initial start-up, final adjusting and testing of the Burners and Controls in the presence of the Owners Operating Personnel.
2. The process of Start-Up and Commissioning shall include Purging of the Boiler(s); Burner Operation Tests, including CO sampling, Stack Temperature(s); CO_2 sampling; Tests for Venting; Ignition Tests; Manifold Pressure Tests; Instruction to the Owner and all other such procedures as may be directed by the Consulting Engineer.
3. The final results of a Combustion Efficiency Test with all pertinent Combustion Data shall be logged onto a check sheet which shall be submitted to the Consulting Engineer to prove compliance with this section of the Specifications and for Record purposes.
4. Combustion efficiency testing shall include no less than the following:

    a. Sample and document CO_2 in the flue gas at Low and High rates of fire with recorded Gross and Net Stack Temperatures to establish stack loss value. Each Burner shall be set to operate at the overall best performance and combustion efficiency for which the equipment is designed and capable of.
    b. Adjustment and checkout of all aquastat controls, limits, switches, operating controls, low water cutoff devices, low voltage step control relays, combustion controls, and all Lockout conditions.
    c. He shall supervise purging of the Boiler(s). All required tests for proper venting, which shall include setting and adjusting the Boiler outlet damper to the Boiler manufacturers specifications.
    d. Provide instruction to the Owners Operating Personnel in the procedures to resolve a "Lockout" condition. Operating personnel shall also be instructed in the Operation and routine daily maintenance of the Burner, Combustion Controls, Multiple Boiler Reset Control System and controls during the lightoff process. The Owner shall arrange to have the personnel who require training to be present at the Lightoff.

2.17 FLUE VENTING

A. Provide double wall Chimney for all flue piping from the boilers thru the roof. Specification requirements shall be met by providing Selkirk Metalbestos Model PS or equivalent by Metal-Fab, Schebler or approved equal. Equivalent bids shall specify manufacturer, model number, and other pertinent identification; and attest that the alternate is in compliance with all specification requirements.

B. The factory-built modular connector, manifold and stack system shall be laboratory tested and listed by Underwriters Laboratories for use with building heating equipment and appliances which produce exhausted flue gases at a temperature not exceeding 1000^{o} (F) under continuous operating conditions and not exceeding 1400^{o}F under intermittent operating conditions (see UL103) when burning gaseous, solid or liquid fuels as described in NFPA 211. The stack system shall be designed and installed to be gas tight and thus prevent leakage of combustion products into a building. The system shall be designed to compensate for all flue gas induced thermal expansions.

C. The double wall stack shall have an inner gas carrying pipe of type 304 stainless steel for gas. There shall be a nominal one (1) inch air space between the walls. The outer jacket shall be aluminum coated steel. The materials and construction of the modular sections and accessories shall be as specified by the terms of the product's UL listing.

D. The breeching shall be installed according to the manufacturer's installation instructions and shall comply with any applicable building codes and standards.

E. Inner pipe joints shall be sealed by use of factory supplied V Bands and sealant as specified in the manufacturer's instructions.

F. The entire breeching and stack system from each boiler or appliance to the termination; including accessories, except as noted; shall be from one manufacturer.

G. When installed according to the manufacturer's installation instructions the piping and its supporting system shall resist side loads (whether system is horizontal or vertical) at least 1.5 times the weight per foot of the piping.

H. The breeching shall be warranted against functional failure due to defects in material and manufacturer's workmanship for a period of ten years from date of delivery.

I. Drawings showing the actual layout and drawn to scale shall be provided by the manufacturer. The system shall be installed as designed by the manufacturer and in accordance with the terms of the manufacturer's 10-year warranty and in conjunction with sound engineering practice.

J. The inner diameter for breeching and stack shall be verified by the manufacturer's computations. The computation shall be technically sound, shall follow ASHRAE calculation methods, and incorporate the specific flow characteristics of the inner pipe. The contractor shall furnish the exact boiler model and operating characteristics to the factory representative. Operating characteristics shall include

flue gas flow rate, BTU input, outlet temperature, local altitude, stack layout, and available external pressure at boiler outlet, etc. necessary to determine system operation at maximum and minimum levels of burner turndown range.

K. Technical Services Support: The factory-built modular stack system shall be furnished by a vendor organization which assures design, installation and services coordination; and provides in-warranty and post-warranty unified responsibility for owner, architect, consulting engineer and contractor.

L. System shall be sized and installed as called out on the Drawings, as recommended by the manufacturer, as and as required by code. In addition, provide supports and all other accessories recommended by the manufacturer or required by Code. Provide cleanout tee at base of riser, counterweighted and adjustable barometric damper at each boiler, roof flashing, cap and all other accessories.

M. All venting work must be done by a Massachusetts licensed plumber or gas fitter.

2.18 ELECTRIC CABINET AND UNIT HEATERS

A. Electric heaters shall be factory assembled for surface mount field installation. Enclosures shall be 16-gauge steel with corrosion resistant finish; color selection shall be by Architect. Cabinet and unit heaters shall be Berko, Qmark, Electromode or equal.

B. Coils shall be single terminal, long life electrical fin tube with helical coiled fins. Fan shall be either squirrel cage type or propeller. Provide automatic reset thermal overload protector, integral tamper resistant thermostat, fan speed switch and disconnect switch. Cabinet unit heaters shall include integral tamper resistant thermostats. Unit heaters shall be provided with a contactor and 24 volt step-down control transformer for control by remote low voltage thermostat.

2.19 VIBRATION ISOLATION AND FLEXIBLE CONNECTIONS

A. At duct connections to equipment, provide glass-fabric flexible neoprene connections with a minimum of 6 inch full length and approved by the governmental agencies having jurisdiction. On vehicle exhaust fans provide high temperature rated.

B. Provide 1” deflection spring vibration isolators with seismic and thrust restraints for the energy recovery units.

C. At pipe connections to air to water heat pumps, pumps and hot water unit heaters, provide braided stainless steel flexible pipe connectors as manufactured by Mercer Rubber Co. model #BSS or equal.

D. Hot water unit heaters shall be suspended with double deflection neoprene hangers similar to Mason Industries model #HD.

2.20 LOUVERS

A. Louvers meeting the following specifications shall be furnished and installed where shown on the plans. Louvers shall be stationary type with drainable blades in a 4" louver frame. Each stationary blade shall incorporate an integral drain gutter and each jamb shall incorporate an integral downspout so water drains to blade end, then down the downspouts and out at the louver sill rather than cascading from blade to blade.

B. Each factory-assembled louver section shall be designed to withstand wind loadings of 25 pounds per square foot (100 mph wind equivalent). Louver frames, mullions, and section joints shall be adequately supported from the building structure to withstand this same wind loading.

C. Louver performance data shall be licensed under the AMCA Certified Ratings Program and shall bear the AMCA Certified Ratings Seal. This certified performance data shall include airflow pressure loss and water penetration, and shall demonstrate performance equal to or better than the Greenheck model specified.

A. Louvers shall be Greenheck model #ESD-403 drainable type fabricated from 60637T5 aluminum extrusions of 0.081" nominal wall thickness. Blades shall be positioned at 37° and 45°angles approximately on 4" centers. Each louver shall be equipped with a framed, removable, rear-mounted screen of ¾" x 0.051" expanded flattened aluminum.

B. All exhaust louvers and forced air intake louvers (i.e. louver connected to furnace) shall be provided with bird screens. All passive intake louvers shall be provided with a bird screen and an insect screen.

C. Louver shall be supplied with a Kynar finish applied following a thorough cleaning and pretreatment of the metal surface. Dry film thickness of the Kynar shall be approximately 1.2 mils after baking at 450°F. Color shall be by the architect and shall be selected from the standard color chart, which shall be submitted with the louvers.

2.21 TOTAL ENERGY RECOVERY VENTILATOR UNIT, ERV-1, 2, 3 & 4

A. SYSTEM DESCRIPTION

1. The ventilation equipment shall be Energy Recovery Ventilator (s) (ERV) as manufactured by Daiken, RenewAire, Greenheck or approved equal. Equivalent manufacturers must physical fit within the confines of the specified unit to be allowed as an equal

1. Energy Recovery Ventilator (ERV) shall be a packaged unit as manufactured by Greenheck, Daikin or RenewAire and shall transfer both heat and humidity using static plate core technology or a rotating total energy recovery wheel.

B. QUALITY ASSURANCE

1. The energy recovery cores used in these products shall be third party Certified by AHRI under its Standard 1060 for Energy Recovery Ventilators. AHRI published certifications shall confirm manufacture's published performance for airflow, static pressure, temperature and total effectiveness, purge air (OACF) and exhaust air leakage (EATR). Products that are not currently AHRI Certified will not be accepted.

2. Manufacturer shall be able to provide evidence of independent testing of the core by Underwriters Laboratory (UL), verifying a maximum flame spread index (FSI) of 25 and a maximum smoke developed index (SDI) of 50 thereby meeting NFPA 90A and NFPA 90B requirements for materials in a compartment handling air intended for circulation through a duct system. The method of test shall be UL Standard 723.

3. Unit shall be Listed under UL 1812 Standard for Ducted Air to Air Heat Exchangers. Some exceptions to UL Listing may apply. Units intended for "Outdoor Use" shall be listed using the specific UL requirements for rain penetration, corrosion protection and seal durability and shall be so labeled.

4. The ERV core or wheel shall be warranted to be free of manufacturing defects and to retain its functional characteristics, under circumstances of normal use, for a period of ten years from the date of purchase. The balance-of-unit shall be warranted to be free of manufacturing defects and to retain its functional characteristics, under circumstances of normal use, for a period of two years from the date of purchase.

C. INSTALLATION

1. The installation of all ERV units, duct work, all interconnecting control and power wiring, commissioning and testing shall be carried out by licensed installers in accord with all Codes and requirements.

D. DELIVERY, STORAGE AND HANDLING

1. Unit shall be stored and handled according to the manufacturer's recommendations.

2. The unit will be able to withstand 105°F storage temperatures and 95% relative humidity without adverse effect.

E. WARRANTY

1. The ERV units shall have a manufacturer's parts and defects warranty for a period one (1) year from date of installation If, during this period, any part should fail to function properly due to defects in workmanship or material, it shall be replaced or repaired at the discretion of the manufacturer. This warranty does not include labor.

2. The Energy Transfer Core shall have an additional nine (9) year warranty against defects in material or workmanship. The total warranty period shall be ten (10) years from date of installation.

F. PRODUCTS

1. The energy recovery component shall be of fixed-plate cross-flow construction, with no moving parts.

2. No condensate drain pans or drains shall be allowed and unit shall be capable of operating in both winter and summer conditions without generating condensate.

3. The unit case shall be constructed of G90 galvanized, 20-gauge steel, with lapped corners and zinc plated screw fasteners. The unit roof shall be one piece or have watertight standing seam joints and shall overlap wall panels and doors in order to positively shed water.

4. Access doors shall provide easy access to blowers, ERV cores/wheels and filters. Doors shall have an airtight compression seal using closed cell foam gaskets rated for outdoor exposure. Pressure taps, with captive plugs, shall be provided allowing cross-core pressure measurement allowing for accurate airflow measurement.

5. Case walls and doors shall be insulated with 1 inch, 4 pound density, foil/scrim faced, high-density fiberglass board insulation, providing a cleanable surface and eliminating the possibility of exposing the fresh air to glass fibers, and with minimum R-value of 4.3 (hr·ft2·°F/BTU).

6. The ERV cores shall be protected by a MERV-8 rated, 2” nominal, pleated, disposable filter in both airstreams. Provide four (4) spare sets.

7. Unit shall have single-point power connection and a single-point 24 VAC contactor control connection .

8. Blower motors shall be Premium Efficiency ECM or equal, EISA compliant for energy efficiency. The blower motors shall be totally enclosed (TEFC) and shall be supplied with factory installed motor starters. Direct drive models shall be EISA compliant for energy efficiency with open drip proof design and integral thermal protection. Unit shall be equipped with ECM motors for variable speed balancing and remote control via the EMS.

9. Blowers shall be quiet running, forward curve type and be either direct drive or belt drive. Belt drive motors shall be provided with adjustable pulleys and motor mounts allowing for blower speed adjustment, proper motor shaft orientation and proper belt tensioning.

10. The unit electrical box shall include a factory installed, non-fused disconnect switch and a 24 VAC, Class II transformer/relay package.

G. ACCESSORIES and OPTIONS

1. The ERV shall be provided with ECM motors.

   Provide unit and duct connection orientation per project schedule.

2. Provide double wall construction with 24-gauge galvanized steel liner. Provide exterior rated unit with baked epoxy finish and pitched roof panels for drainage.

3. Units are available single or three phase at a full range of operating voltages. See project schedule.

4. Provide motor horsepower as specified in project schedule. Motors shall be premium efficiency inverter rated. Provide variable frequency drives for balancing and control via EMS.

5. Provide factory installed disconnect fuses.

6. Provide factory installed Variable Frequency Drives (in models where ECM motors are not available) allowing either preset or variable speed operation with appropriate 0-10 volt DC or DDC control signal.

7. Provide factory installed isolation dampers for both air streams. The insulated dampers shall be of a low leakage design and shall not restrict the airstream, reducing airflow, in any way. The dampers shall be opened with a motor actuator powered by the standard unit transformer package and have a spring return for low off-position power consumption.

8. Provide factory installed filter monitors for each airstream.

9. Although defrost mode is not anticipated, units shall have the ability to cycle an Exhaust Only defrost mode when enabled units unitary control.

10. Provide MERV-8 filters for final installation after construction phase. Provide four (4) spare filter sets.

2.22 VARIABLE REFRIGERANT VOLUME AIR CONDITIONING – Three Pipe Heat Recovery

A. SYSTEM DESCRIPTION

The variable capacity, heat recovery air conditioning system shall be a Daikin Variable Refrigerant Volume Series (heat and cool model) split system as specified or equal by Mitsubishi or Panasonic. The system as described herein is based on Daikin. The system shall consist of multiple evaporators, branch selector boxes, REFNET™ joints and headers, a three pipe refrigeration distribution system using PID control and Daikin VRV® condenser unit. The condenser shall be a direct expansion (DX), air-cooled heat recovery, multi-zone air-conditioning system with variable speed inverter driven compressors using R-410A refrigerant. The condensing unit indoor evaporator capacities as scheduled and specified must be met. All zones are each capable of operating separately with individual temperature control. A dedicated hot gas pipe shall be required to ensure optimum heating operation performance. Two-pipe, heat recovery systems utilizing a lower temperature mixed liquid/gas refrigerant to perform heat recovery are not acceptable due to reduced heating capabilities.

The Daikin condensing unit shall be interconnected to indoor unit models FXFQ, FXHQ, FXMQ, FXLQ, FXNQ, FXTQ, FXDQ, FXZQ, FXAQ and FXMQ_MF and shall range in capacity from 7,500 Btu/h to 96,000 Btu/h in accordance with Daikin's engineering data book detailing each available indoor unit. The indoor units shall be connected to the condensing unit utilizing Daikin's REFNET™ specified piping joints and headers to ensure correct refrigerant flow and balancing. T style joints are not acceptable.

Operation of the system shall permit either individual cooling or heating of each indoor unit simultaneously or all of the indoor units associated with each branch of the cool/heat selector box (BSVQ_P / BSV4Q_P / BSV6Q_P). Each indoor unit or group of indoor units shall be able to provide set temperature independently via a local remote controller, an Intelligent Controller, an Intelligent Manager and a BMS interface.

Branch selector boxes shall be located as shown on the drawing. The branch selector boxes shall have the capacity to control up to 216 MBH (cooling) downstream of the branch selector box. Each branch of the branch selector box shall consist of five electronic expansion valves, refrigerant control piping and electronics to facilitate communications between the box and main processor and between the box and indoor units. The branch selector box shall control the operational mode of the subordinate indoor units. The use of five EEV's ensures continuous heating during defrost, no heating impact during changeover and reduced sound levels. The use of solenoid valves for changeover and pressure equalization shall not be acceptable due to refrigerant noise.

The REYQ condensing unit model numbers and the associated number of connectable indoor units per REYQ condensing unit is indicated in the following table. Each indoor unit or group of indoor units shall be independently controlled.

Model Number	Nominal Capacity (Tons)	Number of Connectable Indoor Units
REYQ72PBTJ	6	12
REYQ96PBTJ	8	16
REYQ120PBTJ	10	20

B. VRV IV FEATURES AND BENEFITS
1. Voltage Platform –Heat recovery condensing units shall be available with a 208-230V/3/60 power supply. All units shall be furnished with disconnect switches. NEMA 1 for indoor units and NEMA 3R for outdoor condensing/heat pump units.
2. Advanced Zoning – A single system shall provide for up to 58 zones.
3. Autocharging – Each system shall have a refrigerant auto-charging function.
4. Defrost Heating – Each system shall maintain continuous heating during defrost operation. Reverse cycle (cooling mode) defrost operation shall not be permitted due to the potential reduction in space temperature.
5. Oil Return Heating – Each system shall maintain continuous heating during oil return operation. Reverse cycle (cooling mode) oil return during heating operation shall not be permitted due to the potential reduction in space temperature.
6. Low Ambient Cooling – Each system shall be capable of low ambient cooling operation to -4°F DB.

7. Independent Control – Each indoor unit shall use a dedicated electronic expansion valve for independent control.
8. VFD Inverter Control – Each condensing unit shall use a high efficiency, variable speed "inverter" compressor coupled with inverter fan motors for superior part load performance.
   Compressor capacity shall be modulated automatically to maintain constant suction and condensing pressures while varying the refrigerant volume for the needs of the cooling or heating loads.
   Indoor units shall use PID to control superheat to deliver a comfortable room temperature condition and optimize efficiency.
   a. Flexible Design –
      i. Systems shall be capable of up to 540ft (640ft equivalent) of linear piping between the condensing unit and furthest located indoor unit.
      ii. Systems shall be capable of up to 3,280ft total "one-way" piping in the piping network.
      iii. Systems shall have a vertical (height) separation of up to 295ft between the condensing unit and the indoor units.
      iv. Systems shall be capable of up to 295ft from the first REFNET™ / branch point.
      v. The condensing unit shall have the ability to connect an indoor unit evaporator capacity of up to 200% of the condensing unit capacity.
      vi. Systems shall be capable of 49ft between indoor units.
      vii. Condensing units shall be supported with a fan motor ESP up to 0.32". WG as standard to allow connection of discharge ductwork and to prevent discharge air short circuiting.
   b. Simple Wiring – Systems shall use 16/18 AWG, 2 wire, multi-stranded, non-shielded and non-polarized daisy chain control wiring.
   c. Energy Efficiency – System shall have equivalent or better performance than high efficiency air cooled or water cooled chiller systems.
   d. Outside Air – Systems shall provide outside air capability.
   e. Space Saving – Each system shall have a condensing unit module footprint as small as 3' 5/8" x 2' 6-1/8" (7.66sq ft).
   f. Advanced Diagnostics – Systems shall include a self diagnostic, auto-check function to detect a malfunction and display the type and location.
   g. Each condensing unit shall incorporate contacts for electrical demand shedding.
   h. Advanced Controls – Each system shall have at least one remote controller capable of controlling up to 16 indoor units.
      Each system shall be capable of integrating with open protocol BACnet and LonWorks building management systems.
   i. Low Sound Levels – Each system shall use indoor and condensing units with quiet operation as low as 27 dB(A).

C. QUALITY ASSURANCE

1. The units shall be tested by a Nationally Recognized Testing Laboratory (NRTL), in accordance with ANSI/UL 1995 – Heating and Cooling Equipment and bear the Listed Mark.
2. All wiring shall be in accordance with the National Electric Code (NEC).
3. The system will be produced in an ISO 9001 and ISO 14001 facility, which are standards set by the International Standard Organization (ISO). The system shall be factory tested for safety and function.
4. Mechanical equipment for wind-born debris regions shall be designed in accordance with ASCE 7-2010 and installed to resist the wind pressures on the equipment and the supports.
5. The condensing unit will be factory charged with R-410A.

D. DELIVERY, STORAGE AND HANDLING
1. Unit shall be stored and handled according to the manufacturer's recommendations.

E. STANDARD LIMITED WARRANTY

Manufacturer warrants to the customer who is the original owner and user of the products specified herein that under normal use and maintenance for comfort cooling and conditioning applications such products (the "Products") will be free from defects in material or workmanship. This warranty applies to parts only and is limited in duration to one (1) year from the earlier to occur of (a) the date of original installation, whether or not actual use begins on that date, or (b) eighteen (18) months from the date of shipment by Daikin AC. Customer must present proof of the original date of receipt and of installation of the Product in order to establish the effective date of this warranty. Otherwise the effective date will be deemed to be the date of manufacture plus sixty (60) days. Repaired or replacement parts are warranted for the balance of the warranty period applicable to the original part following the date on which the repaired or replacement part is provided to the Customer.

F. EXTENDED WARRANTY

For its compressors only, Daikin AC provides the above warranty (which is applicable to parts only) for a seven (7) year period. This extended warranty for compressors is limited in duration to seven (7) years from the earlier to occur of (a) the date of original installation, whether or not actual use begins on that date, or (b) eighteen (18) months from the date of shipment by Daikin AC, and applies to the compressor and compressor parts only. The effective date of this extended warranty shall be established as above.

G. INSTALLATION REQUIREMENTS

The system must be installed by a Daikin factory trained contractor/dealer. The bidders shall be required to submit training certification proof with bid documents. The mechanical contractor's installation price shall be based on the systems

installation requirements. The mechanical contractor bids with complete knowledge of the HVAC system requirements. Untrained contractors who wish to bid this project may contact the manufacturer's representative to arrange training prior to bid day.

F. The VRVIV REYQ system shall perform as indicated below.

Model Number	System IEER* (part load - ducted)	System IEER* (part load – non-ducted)	System IEER* (part load - mixed)
REYQ72PBTJ	21.3	25.1	23.2
REYQ96PBTJ	19.7	22.9	21.3
REYQ120PBTJ	16.1	21.3	18.7
REYQ264PBTJ	18.1	18.7	18.4
REYQ288PBTJ	17.5	19.0	18.3
REYQ312PBTJ	16.2	16.9	16.6
REYQ336PBTJ	15.9	15.6	15.8

Model Number	System SCHE* (part load - ducted)	System SCHE* (part load – non-ducted)	System SCHE* (part load - mixed)
REYQ72PBTJ	18.0	21.1	19.6
REYQ96PBTJ	15.4	20.0	17.7
REYQ120PBTJ	15.3	19.6	17.5

Model Number	System EER* (full load - ducted)	System EER* (full load – non-ducted)	System EER* (full load - mixed)
REYQ72PBTJ	13.8	15.4	14.6
REYQ96PBTJ	12.1	13.2	12.7
REYQ120PBTJ	11.3	12.1	11.7
REYQ336PBTJ	10.2	10.2	10.2

Model Number	System COP@47F* (full load - ducted)	System COP@47F* (full load – non-ducted)	System COP@47F* (full load - mixed)
REYQ72PBTJ	3.80	4.20	4.00
REYQ96PBTJ	3.60	3.70	3.65
REYQ120PBTJ	3.40	3.60	3.50

Performance Conditions

Cooling: indoor temp. of 80°F DB, 67°F WB and outdoor temp. of 95°F DB.
Heating: indoor temp. of 70°F DB and outdoor temp. of 47°F DB, 43°F WB.
Equivalent piping length: 25ft

* The system IEER, SCHE, EER and COP values for systems sized 300MBH and smaller are certified to AHRI Std. 1230. Systems sized larger than 300MBH are rated to AHRI Std. 1230.

G. OPERATING RANGE

The operating range in cooling will be (-4°F) 23°F DB ~ 122°F DB.
Each system as standard shall be capable of on site reprogramming to allow low ambient cooling operation to -4°F DB.

The operating range in heating will be 0°F DB – 77°F DB / -4°F WB – 60°F WB.
Simultaneous cooling/heating operating range will be (-4°F) 23°F WB ~ 60°F WB.

Cooling mode indoor room temperature range will be 57°F-77°F WB.
Heating mode indoor room temperature range will be 59°F-80°F DB.

H. REFRIGERANT PIPING

The system shall be capable of refrigerant piping up to 540 actual feet or 620 equivalent feet from the condensing unit to the furthest indoor unit, a total combined liquid line length of 3,280 feet of piping between the condensing and indoor units with 295 feet maximum vertical difference, without any oil traps. REFNET™ piping joints and headers shall be used to ensure proper refrigerant balance and flow for optimum system capacity and performance. T style joints shall not be acceptable as this will negatively impact proper refrigerant balance and flow for optimum system capacity and performance.

I. DESIGN BASIS

The HVAC equipment basis of design is Daikin AC. All bidders shall furnish the minimum system standards as defined by the base bid model numbers, model families or as otherwise specified herein (see Key General Specifications Alternate Supplier Checklist). In any event, the contractor shall be responsible for all specified items and intents of this document without further compensation.

J. CONDENSING UNIT

A. General: The condensing unit is designed specifically for use with VRVIV series components.

1. The condensing unit shall be factory assembled and pre-wired with all necessary electronic and refrigerant controls. The refrigeration circuit of the condensing unit shall consist of Daikin scroll compressors, motors, fans, condenser coil, electronic expansion valves, solenoid

valves, 4-way valve, distribution headers, capillaries, filters, shut off valves, oil separators, service ports and refrigerant regulator. High/low pressure gas line, liquid and suction lines must be individually insulated between the condensing and indoor units.

2. The condensing unit can be wired and piped with access from the left, right, rear or bottom.
3. The connection ratio of indoor units to condensing unit shall be permitted up to 200%.
4. Each condensing system shall be able to support the connection of up to 56 indoor units dependant on the model of the condensing unit.
5. The sound pressure level standard shall be that value as listed in the Daikin engineering manual for the specified models at 3 feet from the front of the unit. The condensing unit shall be capable of operating automatically at further reduced noise during night time.
6. The system will automatically restart operation after a power failure and will not cause any settings to be lost, thus eliminating the need for reprogramming.
7. The unit shall incorporate an auto-charging feature.
8. The condensing unit shall be modular in design and should allow for side-by-side installation with minimum spacing.
9. The following safety devices shall be included on the condensing unit; high pressure sensor and switch, low pressure sensor, control circuit fuses, crankcase heaters, fusible plug, overload relay, inverter overload protector, thermal protectors for compressor and fan motors, over current protection for the inverter and anti-recycling timers.
10. To ensure the liquid refrigerant does not flash when supplying to the various indoor units, the circuit shall be provided with a sub-cooling feature.
11. Oil recovery cycle shall be automatic occurring 2 hours after start of operation and then every 8 hours of operation. Each system shall maintain continuous heating during oil return operation. Reverse cycle (cooling mode) oil return during heating operation shall not be permitted due to the potential reduction in space temperature.
12. The condensing unit shall be capable of heating operation at 0°F dry bulb ambient temperature without additional low ambient controls or an auxiliary heat source.
13. The system shall continue to provide heat to the indoor units in heating operation while in the defrost mode. Reverse cycle (cooling mode) defrost during heating operation shall not be permitted due to the potential reduction in space temperature.

B. Unit Cabinet:

1. The condensing unit shall be completely weatherproof and corrosion resistant. The unit shall be constructed from rust-proofed mild steel panels coated with a baked enamel finish.

C. Fan:

1. The condensing unit shall consist of one or more propeller type, direct-drive 350 or 750 W fan motors that have multiple speed operation via a DC (digitally commutating) inverter.

Model Number	Fan Motor Output (W) & Quantity
REYQ72PBTJ	350 x 2
REYQ96PBTJ	350 x 2
REYQ120PBTJ	350 x 2

2. The condensing unit fan motor shall have multiple speed operation of the DC (digitally commutating) inverter type, and be of high external static pressure and shall be factory set as standard at 0.12 in. WG. A field setting switch to a maximum 0.32 in. WG pressure is available to accommodate field applied duct for indoor mounting of condensing units.
3. The fan shall be a vertical discharge configuration with a nominal airflow maximum range of 6,700 CFM to 20,650 CFM dependent on model specified.
4. Nominal sound pressure levels shall be as shown below.

Model Number	Sound Pressure Level dB(A)
REYQ72PBTJ	58
REYQ96PBTJ	58
REYQ120PBTJ	60

5. The fan motor shall have inherent protection and permanently lubricated bearings and be mounted.
6. The fan motor shall be provided with a fan guard to prevent contact with moving parts.
7. Night setback control of the fan motor for low noise operation by way of automatically limiting the maximum speed shall be a standard feature. Operation sound level shall be selectable from 3 steps as shown below.

Operation Sound dB(A)	Night Mode Sound Pressure Level dB(A)
Step 1 max.	55
Step 2 max.	50
Step 3 max.	45

D. Condenser Coil:

1. The condenser coil shall be manufactured from copper tubes expanded into aluminum fins to form a mechanical bond.
2. The heat exchanger coil shall be of a waffle louver fin and rifled bore tube design to ensure high efficiency performance.
3. The heat exchanger on the condensing units shall be manufactured from Hi-X seamless copper tube with N-shape internal grooves mechanically bonded on to aluminum fins to an e-Pass Design.
4. The fins are to be covered with an anti-corrosion acrylic resin and hydrophilic film type E1.
5. The pipe plates shall be treated with powdered polyester resin for corrosion prevention. The thickness of the coating must be between 2.0 to 3.0 microns.

E. Compressor:
1. The Daikin inverter scroll compressors shall be variable speed (PVM inverter) controlled which is capable of changing the speed to follow the variations in total cooling and heating load as determined by the suction gas pressure as measured in the condensing unit. In addition, samplings of evaporator and condenser temperatures shall be made so that the high/low pressures detected are read every 20 seconds and calculated. With each reading, the compressor capacity (INV frequency or STD ON/OFF) shall be controlled to eliminate deviation from target value.
2. The inverter driven compressor in each condensing unit shall be of highly efficient reluctance DC (digitally commutating), hermetically sealed scroll “G2-type” with a maximum speed of 7,980 rpm.
3. Neodymium magnets shall be adopted in the rotor construction to yield a higher torque and efficiency in the compressor instead of the normal ferrite magnet type. At complete stop of the compressor, the neodymium magnets will position the rotor into the optimum position for a low torque start.
4. The capacity control range shall be as low as 4% to 100%.
5. Each non-inverter compressor shall also be of the hermetically sealed scroll type.
6. Each compressor shall be equipped with a crankcase heater, high pressure safety switch, and internal thermal overload protector.
7. Oil separators shall be standard with the equipment together with an intelligent oil management system.
8. The compressor shall be spring mounted to avoid the transmission of vibration.
9. Units sized 6-12 tons shall contain a minimum of 2 compressors. 14 ton units shall contain a minimum of 3 compressors. 16-20 ton units shall contain a minimum of 4 compressors. 22-24 ton units shall contain a minimum of 5 compressors. 26-28 ton units shall contain a minimum of 6 compressors. In the event of compressor failure the

remaining compressors shall continue to operate and provide heating or cooling as required at a proportionally reduced capacity. The microprocessor and associated controls shall be designed to specifically address this condition.

Tonnage	Number of Compressors	Compressor Types
6	2	1 inverter + 1 fixed
8	2	1 inverter + 1 fixed
10	2	1 inverter + 1 fixed

10. In the case of multiple condenser modules, conjoined operation hours of the compressors shall be balanced by means of the Duty Cycling Function, ensuring sequential starting of each module at each start/stop cycle, completion of oil return, completion of defrost or every 8 hours.

F. Electrical:

1. The power supply to the condensing unit shall be 208-230 volts, 3 phase, 60 hertz +/- 10%. Furnish disconnect switch for each condensing/heat pump unit.

Power Supply Voltage	Voltage Range
208-230V/3/60	187V-253V

Model	MCA	MOP	Compressor RLA
REYQ72PBTJ	36.1	40	4.8 + 14.0
REYQ96PBTJ	43.8	45	8.4 + 14.0
REYQ120PBTJ	44.2	50	12.0 + 13.6

2. The control voltage between the indoor and condensing unit shall be 16VDC non-shielded, stranded 2 conductor cable.
3. The control wiring shall be a two-wire multiplex transmission system, making it possible to connect multiple indoor units to one condensing unit with one 2-cable wire, thus simplifying the wiring installation.
4. The control wiring lengths shall not exceed as shown below.

	Condenser to Indoor Unit	Condenser to Central Controller	Indoor Unit to Remote Control
Control Wiring Length	6,665 ft	3,330 ft	1,665 ft
Wire Type	16/18 AWG, 2 wire, non-polarity, non-shielded, stranded		

K. BSV(4/6)Q_P BRANCH SELECTOR BOX FOR VRVIV HEAT RECOVERY SYSTEM

A. General: The BSVQ36PVJU, BSVQ60PVJU, BSVQ96PVJU, BSV4Q36PVJU and BSV6Q36PVJU branch selector boxes are designed specifically for use with VRVIV series heat recovery system components.

1. These selector boxes shall be factory assembled, wired, and piped.
2. These BSVQ_P / BSV4Q_P / BSV6Q_P branch controllers must be run tested at the factory.
3. These selector boxes must be mounted indoors.
4. When simultaneously heating and cooling, the units in heating mode shall energize their subcooling electronic expansion valve.
5. The number of connectable indoor units shall be in accordance with the table below:

Model Number	Maximum Connectable Cooling Capacity	Maximum Number of Connectable Indoor Units Per Branch
BSVQ36PVJU	36,000 Btu/h	5
BSVQ60PVJU	60,000 Btu/h	8
BSVQ96PVJU	96,000 Btu/h	8
BSV4Q36PVJU	144,000 Btu/h	5
BSV6Q36PVJU	216,000 Btu/h	5

B. Unit Cabinet:

1. These units shall have a galvanized steel plate casing.
2. Each cabinet shall house 5 electronic expansion valves for refrigerant control per branch.
3. The cabinet shall contain one subcooling heat exchanger per branch.
4. The unit shall have sound absorption thermal insulation material made of flame and heat resistant foamed polyethylene.
5. Nominal sound pressure levels shall be as shown below.

Model Number	Sound Level dB(A) Operating	Sound Level dB(A) Stopping
BSVQ36PVJU	42	32
BSVQ60PVJU	43	32
BSVQ96PVJU	44	34
BSV4Q36PVJU	48	38
BSV6Q36PVJU	50	40

C. Dimensions:

1. Each BSVQ_P unit shall be no larger than 8-3/16” x 15-5/16” x 12-7/8”.
2. Each BSV4Q_P shall be no larger than 8-1/4” x 41-1/2” x 25”.
3. Each BSV6Q_P shall be no larger than 8-1/4” x 62-1/8” x 25”.

D. Refrigerant Valves:

1. The unit shall be furnished with 5 electronic expansion valves per branch to control the direction of refrigerant flow. The use of solenoid valves for changeover and pressure equalization shall not be acceptable due to refrigerant noise.
2. The refrigerant connections must be of the braze type.
3. Each circuit shall have at least one (36,000 Btu/h indoor unit or smaller for the BSVQ36PVJU / BSV4Q36PVJU / BSV6Q36PVJU, 60,000 Btu/h indoor unit or smaller for the BSVQ60PVJU and 96,000 Btu/h indoor unit or smaller for the BSVQ96PVJU) branch selector box.
4. Multiple indoor units may be connected to a branch selector box with the use of a REFNET™ joint provided they are within the capacity range of the branch selector.

E. Condensate Removal:

1. The unit shall not require provisions for condensate removal.

F. Electrical:

1. The unit electrical power shall be 208/230 volts, 1 phase, 60 hertz.
2. The unit shall be capable of operation within the limits of 187 volts to 255 volts.
3. The minimum circuit amps (MCA) shall be 0.1 and the maximum overcurrent protection amps (MOP) shall be 15.
4. The control voltage between the indoor and condensing unit shall be 16VDC non-shielded 2 conductor cable.

L. HVAC EQUIPMENT ALTERNATE (GENERAL INFORMATION)

1. The alternate equipment supplier shall provide to the bidding mechanical contractor a complete equipment data package. This package shall include, but is not limited to, equipment capacities at the design condition, power requirements, indoor units CFM/static pressures, fan curves, installation requirements, and physical dimensions. Nominal performance data is not acceptable.

   The mechanical contractor shall request and receive the equipment data package 15 days prior to bid date and submit this package with the alternate bid.

   The mechanical contractor shall list the equipment supplier and submit the required data package with the bid detailing a complete comparison of the proposed alternate equipment to the specified equipment and the associated

cost reduction of the alternate equipment. The contractor bids an alternate manufacturer with full knowledge that the manufacturer's product may not be acceptable or approved.

2. The alternate equipment supplier shall furnish a complete drawing package to the mechanical contractor 15 days prior to bid day for bidding and installation. The drawing format shall be .dxf or equivalent, on 30"x42" sheets. The HVAC and electrical series design documents will be made available in electronic format for use by the equipment supplier in preparing their drawings. The alternate equipment supplier shall prepare the following drawings:

XXX HVAC Floor Plan
XXX HVAC Refrigerant Piping Plan
XXX HVAC Refrigerant Piping/Controls Details
XXX HVAC Details
XXX HVAC Schedules

The alternate equipment supplier shall draft all piping circuits, components, overall building control schematic, detailed control wiring diagrams, system details and schedules for their system. The drawings shall convey all requirements to successfully install the alternate equipment suppliers system.

Provide (2) drawing package sets plotted on 20 lb. vellum. Provide (1) drawing package in electronic format (.dxf files) on CD.

The submitted documents shall be complete system designs and show no less information than the HVAC equipment/controls contract bid documents.

3. The equipment supplier shall submit as part of the equipment data package condensing unit data sheets. Data sheets to include the following:

Capacities at project design conditions: Cooling
Cooling (Btu/h)

Cooling Input Power – ducted (kW)
Cooling Input Power – ductless (kW)
Cooling Input Power – mixed (kW)

Part Load IEER – ducted
Part Load IEER – ductless
Part Load IEER – mixed

SCHE

Full Load EER – ducted
Full Load EER – ductless
Full Load EER - mixed

Capacities at project design conditions: Heating
Heating (Btu/h)

Heating Input Power – ducted (kW)
Heating Input Power – ductless (kW)
Heating Input Power – mixed (kW)

Full Load COP@47F – ducted
Full Load COP@47F – ductless
Full Load COP@47F – mixed

Full Load COP@17F – ducted
Full Load COP@17F – ductless
Full Load COP@17F – mixed

The submitted capacity and efficiency performance must meet or exceed the listed performance on the schedule at the designed space conditions including de-rate factors for defrost if applicable and refrigerant piping losses.

Operating Temperature Range:
Cooling
Heating

Power Supply:
Maximum Circuit Amps (MCA)
Maximum Overcurrent Protection Amps (MOP)
Maximum Starting Current (MSC)
Condenser Fan Motor

Refrigerant:
Refrigerant Type/Charge
Control

Unit Data:
Max. Number of Indoor Units
Sound Pressure Level at 3ft. dB(A)
Weight (lbs)
Dimensions

4. The equipment supplier shall guarantee the performance of their system and all published data submitted. Performance shall be based on the design criteria below.

Room Temperature (Cooling): 75 F
Room Temperature (Heating): 72F
Ambient Temperature (Summer): 90F
Ambient Temperature (Winter): 5F
Defrost De-rate Factor: as applicable
Refrigerant Piping Loss: see plans

5. The alternate equipment supplier shall submit with bid, indoor unit data sheets. Data sheets to include the following:

Capacities at project design conditions:
Cooling (Btu/h)
Cooling Input Power (kW)
Part Load IEER
SCHE
Full Load EER
Heating (Btu/h)
Heating Input Power (kW)
Full Load COP@47F
Full Load COP@17F
Air Flow (CFM)

External Static Pressure (ESP)
Electrical Data (MCA, MOP, MSC, RLA)
Weight (lbs)
Dimensions

M FXZQ – 4 WAY CEILING CASSETTE UNIT (2'x2')

1. General: Daikin indoor unit model FXZQ shall be a ceiling cassette fan coil unit, operable with R-410A refrigerant, equipped with an electronic expansion valve, for installation into the ceiling cavity equipped with an air panel grill. It shall be available in capacities from 7,500 Btu/h to 18,000 Btu/h. Model numbers are FXZQ07MVJU9, FXZQ09MVJU9, FXZQ12MVJU9, FXZQ15MVJU9, FXZQ18MVJU9 to be connected to outdoor unit model RXYQ / RXYMQ / RWEYQ heat pump and REYQ / RWEYQ heat recovery model. It shall be a four-way air distribution type, white (RAL9010), impact resistant with a washable decoration panel. The supply air is distributed via motorized louvers which can be horizontally and vertically adjusted from 0° to 90°. Computerized PID control shall be

used to control superheat to deliver a comfortable room temperature condition. The unit shall be equipped with a programmed drying mechanism that dehumidifies while limiting changes in room temperature when used with Daikin remote control BRC1E72 and BRC2A71. The indoor units sound pressure shall range from 29 dB(A) to 34 dB(A) at low speed measured at 5 feet below the unit.

2. Performance: Each unit's performance is based on nominal operating conditions.
3. Indoor Unit:
   a. The Daikin indoor unit FXZQ shall be completely factory assembled and tested. Included in the unit is factory wiring, piping, electronic proportional expansion valve, control circuit board, fan motor thermal protector, flare connections, condensate drain pan, condensate drain pump, condensate safety shutoff and alarm, self-diagnostics, auto-restart function, 3-minute fused time delay, and test run switch.
   b. Indoor unit and refrigerant pipes will be charged with dehydrated air prior to shipment from the factory.
   c. Both refrigerant lines shall be insulated from the outdoor unit.
   d. The 4-way supply air flow can be field modified to 3-way and 2-way airflow to accommodate various installation configurations including corner installations.
   e. Return air shall be through the concentric panel, which includes a resin net mold resistant filter.
   f. The indoor units shall be equipped with a condensate pan and condensate pump. The condensate pump provides up to 21" of lift and has a built in safety shutoff and alarm.

Model Number	**Cooling** (Indoor 75°F DB / 62°F WB, Outdoor 95°F DB, 25 ft pipe length)	**Heating** (Indoor 70°F DB / 35°F WB, Outdoor 5°F DB, 25 ft pipe length)
FXZQ07MVJU9	7,500	8,700
FXZQ09MVJU9	9,500	11,100
FXZQ12MVJU9	12,000	14,000
FXZQ15MVJU9	15000	17,500
FXZQ18MVJU9	18,000	21,000

   g. The indoor units shall be equipped with a return air thermistor.
   h. All electrical components are reached through the decoration panel, which reduces the required side service access.
   i. The indoor unit will be separately powered with 208~230V/1-phase/60Hz.

j. The voltage range will be 253 volts maximum and 187 volts minimum.

4. Unit Cabinet:
   a. The cabinet shall be space saving and shall be located into the ceiling.
   b. Three auto-swing positions shall be available to choose, which include standard, draft prevention and ceiling stain prevention.
   c. The airflow of the unit shall have the ability to shut down one or two sides allowing for simpler corner installation.
   d. Fresh air intake shall be possible by way of direct duct installation to the side of the indoor unit cabinet.
   e. A branch duct knockout shall exist for branch ducting supply air.
   f. The cabinet shall be constructed with sound absorbing foamed polystyrene and polyethylene insulation.
5. Fan:
   a. The fan shall be direct-drive turbo fan type with statically and dynamically balanced impeller with high and low fan speeds available.
   b. The fan motor shall operate on 208/230 volts, 1 phase, 60 hertz with a motor output range from 0.06 to 0.12 HP.
   c. The airflow rate shall be available in high and low settings.
   d. The fan motor shall be thermally protected.
6. Filter:
   a. For console, wall hung and cassette style units provide return air filter which shall be filtered by means of a washable long-life filter with mildew proof resin. Provide 1 spare filter for each unit.
   b. For ducted units provide 1” filter rack capable of supporting MERV 7 pleated filters. Provide four (4) sets of filters for each fan coil MERV 7.
7. Coil:
   a. Coils shall be of the direct expansion type constructed from copper tubes expanded into aluminum fins to form a mechanical bond.
   b. The coil shall be of a waffle louver fin and high heat exchange, rifled bore tube design to ensure highly efficient performance.
   c. The coil shall be a 2-row cross fin copper evaporator coil with 17 FPI design completely factory tested.
   d. The refrigerant connections shall be flare connections and the condensate will be 1 -1/32 inch outside diameter PVC.
   e. A condensate pan shall be located under the coil.
   f. A condensate pump with a 21 inch lift shall be located below the coil in the condensate pan with a built in safety alarm.
   g. A thermistor will be located on the liquid and gas line.
8. Electrical:

a. A separate power supply will be required of 208/230 volts, 1 phase, 60 hertz. The acceptable voltage range shall be 187 to 253 volts.
b. Transmission (control) wiring between the indoor and outdoor unit shall be a maximum of 3,280 feet (total 6,560 feet).
c. Transmission (control) wiring between the indoor unit and remote controller shall be a maximum distance of 1,640 feet.

9. Control:
   a. The unit shall have controls provided by Daikin to perform input functions necessary to operate the system.
   b. The unit shall be compatible with interfacing with a BMS system via optional LonWorks or BACnet gateways.
   c. The unit shall be compatible with a Daikin intelligent Touch advanced multi-zone controller or an intelligent Manager IV customizable BMS. Consult with Daikin prior to applying controls.
10. Accessories to be provided:
    a. Direct fresh air intake kit (KDDQ44X60) unless shown otherwise on plans.
    b. Supply air duct connections where indicated on plans.
    c. Daikin wall mounted, hard wired remote sensor kit. The sensor for detecting the temperature can be placed away from the indoor unit (branch wiring is included in the kit coordinate for longer lengths).

N FXSQ_P - CONCEALED CEILING DUCTED UNIT (Med. Static)

1. General: Daikin indoor unit FXMQ_P shall be a built-in ceiling concealed fan coil unit, operable with refrigerant R-410A, equipped with an electronic expansion valve, direct-drive DC (ECM) type fan with auto CFM adjustment at commissioning, for installation into the ceiling cavity. It is constructed of a galvanized steel casing. It shall be available in capacities from 7,500 Btu/h to 48,000 Btu/h. Model numbers are FXSQ07PVJU, FXSQ09PVJU, FXSQ12PVJU, FXSQ18PVJU, FXSQ24PVJU, FXSQ30PVJU, FXSQ36PVJU and FXSQ48PVJU to be connected to outdoor unit model RXYQ / RXYMQ / RWEYQ heat pump and REYQ / RWEYQ heat recovery model. It shall be a horizontal discharge air with horizontal return air configuration. All models feature a low height cabinet making them applicable to ceiling pockets that tend to be shallow. Computerized PID control shall be used to control superheat to deliver a comfortable room temperature condition. The unit shall be equipped with a programmed drying mechanism that dehumidifies while limiting changes in room temperature when used with Daikin remote control BRC1E72 and BRC2A71. Included as standard equipment, a condensate drain pan and drain pump kit that pumps to 18-3/8” from

the drain pipe opening. The indoor units sound pressure shall range from 29 dB(A) to 40 dB(A) at low speed measured 5 feet below the ducted unit.

2. Performance: Each unit's performance is based on nominal operating conditions:

Model Number	**Cooling** (Indoor 75°F DB / 62°F WB, Outdoor 95°F DB, 25 ft pipe length)	**Heating** (Indoor 70°F DB / 35°F WB, Outdoor 5°F DB, 25 ft pipe length)
FXSQ07PVJU	7,500	8,500
FXSQ09PVJU	9,500	10.500
FXSQ12PVJU	12,000	13,500
FXSQ18PVJU	18,000	20,000
FXSQ24PVJU	24,000	27,000
FXSQ30PVJU	30,000	34,000
FXSQ36PVJU	36,000	40,000
FXSQ48PVJU	48,000	54,000

3. Indoor Unit:
   a. The Daikin indoor unit FXSQ_P shall be completely factory assembled and tested. Included in the unit is factory wiring, piping, electronic proportional expansion valve, control circuit board, fan motor thermal protector, flare connections, condensate drain pan, condensate drain pump, condensate safety shutoff and alarm, self-diagnostics, auto-restart function, 3-minute fused time delay, and test run switch. The unit shall be equipment with automatically adjusting external static pressure logic that is selectable during commissioning. This adjusts the airflow based on the installed external static pressure.
   b. Indoor unit and refrigerant pipes will be charged with dehydrated air prior to shipment from the factory.
   c. Both refrigerant lines shall be insulated from the outdoor unit.
   d. The indoor units shall be equipped with a condensate pan and condensate pump. The condensate pump provides up to 18-3/8" of lift from the center of the drain outlet and has a built in safety shutoff and alarm.
   e. The indoor units shall be equipped with a return air thermistor.
   f. The indoor unit will be separately powered with 208~230V/1-phase/60Hz.
   g. The voltage range will be 253 volts maximum and 187 volts minimum.
4. Unit Cabinet:

a. The cabinet shall be located into the ceiling and ducted to the supply and return openings.
b. The cabinet shall be constructed with sound absorbing foamed polystyrene and polyethylene insulation.

5. Fan:
   a. The fan shall be direct-drive DC (ECM) type fan, statically and dynamically balanced impeller with three fan speeds available.
   b. The unit shall be equipment with automatically adjusting external static pressure logic selectable during commissioning.
   c. The fan motor shall operate on 208/230 volts, 1 phase, 60 hertz with a motor output range of 0.12 to 0.47 HP respectively.
   d. The airflow rate shall be available in three settings.
   e. The fan motor shall be thermally protected.
   f. The fan motor shall be equipped as standard with adjustable external static pressure (ESP) settings.
   g. Fan motor external static pressure range for nominal airflow:

Model Number	Fan ESP (in. WG)
FXSQ07PVJU	0.40 – 0.12
FXSQ09PVJU	0.40 – 0.12
FXSQ12PVJU	0.40 – 0.12
FXSQ18PVJU	0.80 – 0.20
FXSQ24PVJU	0.80 – 0.20
FXSQ30PVJU	0.80 – 0.20
FXSQ36PVJU	0.80 – 0.20
FXSQ48PVJU	0.80 – 0.20

6. Coil:
   a. Coils shall be of the direct expansion type constructed from copper tubes expanded into aluminum fins to form a mechanical bond.
   b. The coil shall be of a waffle louver fin and high heat exchange, rifled bore tube design to ensure highly efficient performance.
   c. The coil shall be a 3 row cross fin copper evaporator coil with 13 fpi design completely factory tested.
   d. The refrigerant connections shall be flare connections and the condensate will be 1-1/4” outside diameter PVC.
   e. A condensate pan shall be located under the coil.
   f. A condensate pump with an 18-3/8” lift shall be located below the coil in the condensate pan with a built in safety alarm.
   g. A thermistor will be located on the liquid and gas line.
7. Electrical:

a. A separate power supply will be required of 208/230 volts, 1 phase, 60 hertz. The acceptable voltage range shall be 187 to 253 volts.
b. Transmission (control) wiring between the indoor and outdoor unit shall be a maximum of 3,280 feet (total 6,560 feet).
c. Transmission (control) wiring between the indoor unit and remote controller shall be a maximum distance of 1,640 feet.
d. Provide NEMA 1 disconnect switch.

8. Control:
   a. The unit shall have controls provided by Daikin to perform input functions necessary to operate the system.
   b. The unit shall be compatible with interfacing with a BMS system via optional LonWorks or BACnet gateways.
   c. The unit shall be compatible with a Daikin intelligent Touch advanced multi-zone controller or an intelligent Manager IV customizable BMS. Consult with Daikin prior to applying controls.
9. Accessories to be provided:
   a. The Daikin wall mounted, hard wired remote sensor. The sensor for detecting the temperature can be placed away from the indoor unit (branch wiring is included in the kit coordinate wire length).
   b. For ducted units provide 1" filter rack capable of supporting MERV 7 pleated filters. Provide four (4) sets of filters for each fan coil MERV 7.

O. VRF Controls (see also Automatic Temperature Controls):

1. Physical characteristics

   a. General:
      1. The VRV Controls Network shall be capable of supporting remote controllers, schedule timers, system controllers, centralized controllers, an integrated web based interface, graphical user workstation, and system integration to Building Management Systems via BACnet®. BacNet interface card must be provided.

      2. The Open Protocol Interface shall be made from stainless steel. Each interface shall have a battery backup and LED lights to display status/error.

2. Electrical characteristics

   a. General:

The Open Protocol Interface will require 24 VAC to power the unit. The Open Protocol Interface shall supply 16 volts DC to the communication bus on the F1F2 (out-out) terminal of the outdoor unit. The voltage may rise or fall in relation to the transmission packets that are sent and received.

b. Wiring:
   1. The Open Protocol Interface communication wiring shall be terminated in a daisy chain design at the outdoor unit, which is then daisy chained to branch selector (Heat Recovery system), then daisy chained to each indoor unit in the system and terminating at the farthest indoor unit. The termination of the wiring shall be non-polar. The remote control wiring shall run from the indoor unit control terminal block to the remote controller connected with that indoor unit.

c. Wiring size:
   2. Wiring shall be non-shielded, 2-conductor sheathed vinyl cord or cable and 18 AWG stranded copper wire.

d. Provide NEMA 1 disconnect switches for all fan coil units and NEMA 3R disconnect switches for all condensing units.

3. VRV Controls Network
   The VRV Controls Network is made up of local remote controllers, multi-zone controllers, advanced multi-zone controllers, and open protocol network devices that transmit information via the communication bus. The VRV Controls Network shall also have the ability to be accessed via a networked PC. The VRV Controls Network supports operation monitoring, scheduling, error e-mail distribution, general user software, tenant billing, maintenance support, and integration with Building Management Systems (BMS) using open protocol via BACnet® interfaces; all of which blend to provide the optimal control strategy for the best HVAC comfort solution.

4. Open Protocol Interfaces
   The Open Protocol Interfaces are designed as a translator between the DIV-Net communications and the protocols used in BACnet integration. The Daikin VRV Open Protocol Interfaces are compatible with all VRV, SkyAir, and Daikin RA and FTXS indoor units with the use of the KRP928BB2S RA Adapter. The Open Protocol Gateways wiring consist of a stranded non-polar two-wire connection to the outdoor unit. The Open Protocol Interfaces may be wall-mounted and can be used in conjunction with a Building Management System (BMS) to maintain the optimal operation of a minimum of 64 connected indoor unit groups and 128 indoor units (dependent upon interface

option configuration). In cases where a system or unit error may occur, the VRV controllers and the BMS central monitoring system will display an error code as specified by Daikin.

5. Interface for use in BACnet

The Interface for use in BACnet shall provide the ability for a Building Management System (BMS) to control all VRV, SkyAir, and Daikin RA and FTXS indoor units with the use of the KRP928BB2S RA Adapter. It shall be capable of controlling a maximum of 2 DIV-Net systems or 64 indoor unit groups (128 indoor units) connected to a maximum of 10 outdoor units on each DIV-Net system. Each DIV-Net system is independent of each other and each DIV-Net system will terminate on its own DIV-Net port (2 DIV-Net ports standard). The Optional DIV Board (DAM411B51) can be added to the interface. This option provides 2 additional DIV-Net ports to the interface; a total of 4 DIV-Net ports (maximum of 64 indoor unit groups per DIV-Net port) which can handle a maximum of 256 indoor unit groups (512 indoor units) and 40 outdoor units.

The Interface for use in BACnet shall support operations superseding that of the Daikin centralized controller, local remote controller, system configuration, daily/weekly scheduling, monitoring of operation status, and malfunction monitoring.

The Interface for use in BACnet uses a standard open protocol based on ANSI/ASHREA Standard 135. The BACnet Interface has been certified by the BACnet Testing Laboratories (BTL). The BACnet Interface is compatible with BACnet IP (ISO16484-5).

The interface wiring shall consist of a non-polar two-wire connection to the terminals F1F2 (out-out) of the outdoor unit. The Interface for use in BACnet is wall mounted and is used as a translator between the BACnet Building Management System (BMS) and the VRV DIV-Net communication bus to maintain the optimal operation of the connected indoor unit(s).

The Interface for use in BACnet can be used in conjunction with the BRC1E71 (Navigation Remote Controller), the BRC2A71 (Simplified Remote Controller), or the BRC4C82/7E83/7C812/7E818 (Wireless Remote Controller), and DCS601C71 (Intelligent Touch Controller (ITC)) with or without the DCS601A72 (ITC DIV Plus Adapter) to control the same indoor unit groups. No more than 2 remote controllers can be placed in the same group. The remote controller shall require daisy chain wiring for grouping multiple indoor units (up to 16) together. Manual addressing is required of each indoor unit group associated with the Intelligent Touch Controller and the Interfaces for use in BACnet.

The Interface for use in BACnet shall be equipped with one RJ-45 Ethernet port to support interconnection with a network PC via the Internet or Local Area Network (LAN). The Ethernet connection shall be capable of transmission on 10Base-T and/or 100Base-TX connection at 100 Mbps.

The Interface for use in BACnet shall be capable of being configured as a foreign device. It shall be capable of communicating across BACnet Broadcast Management Devices (BBMD) in different subnet networks.

The Interface for use in BACnet shall be capable of supporting Change of Value (COV) notification for all available objects.

The Daikin BACnet Setup Tool shall be available so that certified commissioning personnel/facility staff can securely log into each Interface for use in BACnet via a PC to support the configuration and testing of the Interface for use in BACnet.

a. Mounting:
   The Interface for use in BACnet shall be mounted on the wall or in an enclosure.

b. Display Features:

   i. The Interface for use in BACnet shall be approximately 10.81” x 10.34” in size.
   ii. LED display provides the interface’s operational status and alarm.
   iii. The Interface for use in BACnet shall be capable of displaying indoor unit objects on the BACnet building management system.
   iv. The Interface for use in BACnet shall provide the BACnet building management system the capability to command the setpoint temperature in 1^0F (0.1^0C) increments with a range of 60^0F - 90^0F (16^0C - 32^0C). Display of temperature setpoint information shall be configurable for Fahrenheit or Celsius
   v. The Interface for use in BACnet shall provide the BACnet building management system the capability to display the room temperature in 0.1^0F (0.1^0C) increments with a range of -120^0F - 180^0F (-84^0C - 82^0C). Display of room temperature information shall be configurable for Fahrenheit or Celsius.
   vi. Error codes generated by the indoor units, outdoor units, branch selector boxes, and remote controllers shall be displayed on the BACnet building management system in the event of system abnormality/error with a two digit error code as specified by Daikin.

1) Communication errors between the Interface for use in BACnet and the BACnet building management system shall be displayed with a red flashing LED on the Interface for use in BACnet

c. Basic Operation:
   i. The Interface for use in BACnet will provide up to 28 objects that can be monitored/controlled via the BACnet building management system (see the Interface for use in BACnet Design Guide –EDUS72-749B)
   ii. Capable of controlling up to 64 indoor unit groups (128 indoor units) per DIV-Net port (2 DIV-Net ports standard).
   iii. Optional DIV Board (DAM411B51) can be added to increase DIV-Net ports to a total of 4 DIV-Net ports.
   iv. This provides a total of 256 indoor unit groups (512 indoor units) that can be monitored and controlled via the BACnet building management system
   v. The Building Management System shall control the following group operations:
   vi. On/Off
   vii. Operation Mode (Cool, Heat, Fan, Auto, and Dry)
   viii. Single setpoint setting for Cooling and Heating in the occupied mode.
   ix. Fan status
   x. Fan Speed
   xi. Up to 3 speeds (dependent upon indoor unit type)
   xii. Vane direction (dependent upon indoor unit type)
   xiii. 5 fixed positions or swing position
   xiv. Remote controller permit/prohibit of On/Off, Mode, and Setpoint
   xv. Filter sign reset for indoor units
   xvi. Disable the Intelligent Touch Controller
   xvii. Forced off of indoor units
   xviii. Forced Thermo-off of indoor units
   xix. Energy saving offset of indoor unit setpoint
   xx. Compressor status
   xxi. Thermo-on status
   xxii. Heater status
   xxiii. Capable of providing battery backup power for up to 3 years in total time for the clock.
   xxiv. Settings stored in non-volatile memory

6. Programmability:
   a. The BACnet building management system shall support weekly schedule settings through its programming.
      1) The schedule shall support the indoor unit:

i. On/Off
ii. Each scheduled event shall specify time and target group
iii. Each scheduled event shall include On/Off, Operation Mode, Occupied Cooling Setpoint, Occupied Heating Setpoint, Setup (Cooling) setback setpoint, Setback (Heating) setback setpoint, Remote Controller On/Off Permit/Prohibit, Remote Controller Mode Permit/Prohibit, Remote Controller Setpoint Permit/Prohibit, and Timed Override Enable
iv. Setup (Cooling) and Setback (Heating) setpoints when unit is Off (unoccupied) by Group
v. An override shall be provided for use enabling indoor unit operation during the unoccupied period by the BACnet building management system programming.

b. The BACnet building management system shall support auto-changeover through its programming.
   1) Auto-change shall provide changeover for both Heat Pump and Heat Recovery systems based upon the group configurations. This will allow for the optimal room temperature to be maintained by automatically switching the indoor unit's mode between Cool and Heat in accordance with the room temperature and setpoint temperature.
   2) Changeover shall change the operation mode of the indoor unit that is set as the Changeover Master. The Changeover Master indoor unit shall then change the operation mode of all indoor unit groups daisy chained on the same DIV-Net communication bus to the same outdoor unit in the Heat Pump system or the same branch selector box in the Heat Recovery system.
   3) Changeover to cooling mode shall occur when the room temperature is great than or equal to the cooling setpoint
      i. Differential to be determined by BACnet building management system programming
   4) Changeover to heating mode shall occur when room temperature is less than or equal to the heating setpoint.
      i. Differential to be determined by BACnet building management system programming
   5) Guard timer
      i. Upon changeover, guard timer will prevent another changeover during this period.
      ii. Guard timer should be ignored by a change of setpoint manually from the BMS, Intelligent Touch Controller, Remote Controller, or by schedule.
      iii. Guard timer to be configured by BACnet building management system programming (30 minute minimum recommended)

c. The Interface for use in BACnet shall support force shutdown of associated indoor unit groups.

2.23 AIR TO WATER HEAT PUMP

A. Provide microprocessor controlled, air-cooled liquid chiller/heater heat pump utilizing HFC-410A. Unit shall be rated in accordance with ARI Standard 550/590, latest revision (U.S.A. under 200 tons). Unit construction shall comply with ASHRAE 15 Safety Code, NEC, and ASME applicable codes (U.S.A. codes). Unit shall be manufactured in a facility registered to ISO 9002/BS5750, Part 2 Manufacturing Quality Standard. Unit shall be full load run tested at the factory. Note: For this project the unit shall only operate in the heating mode as an air to water heat pump.

B. Factory assembled; single-piece air-cooled liquid chiller/heater heat pump. Contained within the unit cabinet shall be all factory wiring, piping, controls, refrigerant charge (HFC-410A), and special features required prior to field start-up.

C. Provide air to water heat pump with integral all accessories and options indicated on the schedules and specified herein.

D. Fans

1. Condenser fans shall be direct-driven, 11-blade airfoil cross-section, reinforced polymer construction, shrouded-axial type, and shall be statically and dynamically balanced with inherent corrosion resistance. Air shall be discharged vertically upward.
2. Fans shall be protected by coated steel wire safety guards.

E. Compressors

1. Unit shall have multiple semi-hermetic compressors with internal muffler and check valve.
2. Each compressor shall be equipped with a discharge shutoff valve.
3. Capacity control shall be provided down to 15% of full load.
4. Motor cooling shall be provided by direct liquid injection and protected internal overload thermistor.

F. Cooler

1. Cooler/heater shall be tested and stamped in accordance with ASME code (U.S.A.) for a refrigerant working-side pressure of 220 psig (1517 kPa) and shall be tested for a maximum fluid-side pressure of 300 psig (2068 kPa) (in Canada, 250 psig [1724 kPa] per Canadian National Registry requirements).
2. Shall be equipped with cut groove Victaulic-type fluid connections.

3. Shell/casing shall be insulated with 3 / 4 -in. (19 mm) closed-cell, polyvinyl-chloride foam with a maximum K factor of 0.28.
4. Shall incorporate 2 independent refrigerant circuits.
5. Shall have a cooler drain and vent.
5. Shall incorporate a refrigerant level sensing device for each circuit.

G. Condenser

1. Coil shall be air-cooled with integral subcooler, and shall be constructed of aluminum fins mechanically bonded to seamless copper tubes. The tubes are then cleaned, dehydrated, and sealed.
2. Condenser coils shall be leak tested and shall be pressure tested at 450 psig (3103 kPa).

H. Refrigeration Components

1. Refrigerant circuit components shall include oil separator, high and low side pressure relief device, discharge and liquid line shutoff valves, filter drier, moisture indicating sight glass, electronic expansion device and complete operating charge of both refrigerant HFC-410A and compressor oil.
2. The chiller/heater shall include the ability to isolate the refrigerant charge in either the cooler or the condenser.

I. Controls, Safeties, and Diagnostics

1. Controls

a. Unit must incorporate an open protocol interface card (BacNet) to communicate with the building energy management system. Verify in writing with control contractor to insure proper interface. Map all required operation points back to the EMS system graphic.

b. Unit controls shall include the following minimum components.

1) Microprocessor with non-volatile memory. Battery backup system shall not be accepted.
2) Power and control circuit terminal blocks.
3) ON/OFF control switch.
4) Replaceable solid-state relay panels.
5) Thermistor installed to measure saturated condensing temperature, cooler saturation temperature, compressor return gas temperature, and cooler entering and leaving fluid temperatures.

b. Unit controls shall include the following functions as standard.

1) Automatic circuit lead/lag.
2) Capacity control based on leaving hot water fluid temperature and compensated by rate of change of return-fluid temperature with temperature set point accuracy to 0.1° F (0.06° C).
4) Limiting the heating fluid temperature rise rate at start-up to an adjust-able range of 0.2° F to 2° F (0.11° C to 1.1° C) per minute to prevent excessive demand spikes at start-up.
5) Seven-day time schedule.
6) Leaving hot water fluid temperature reset from return fluid, outdoor-air temperature, space temperature, or 4 to 20 mA input. Note: The EMS system shall command the reset on this project.
7) Demand limit control with 2-stage control (0 to 100% each) or through 4 to 20 mA input (0 to 100%).
8) Amperage readout per compressor with %MTA per compressor.
9) Heat pump mode defrost sequence controller.

c. The control panel shall include, as standard, an LCD display module with a minimum of 4 lines and 20 characters per line, or clear English, Spanish, Portuguese of French language. Display menus shall provide clear language descriptions of all menu items, operating modes, configuration points and alarm diagnostics. Reference to factory codes shall not be accepted. An industrial grade coiled extension cord shall allow the display module to be moved around the chiller/heater. Magnets shall hold the display module to any sheet metal panel to allow hands-free operation. Display module shall have NEMA 4x housing suitable for use in outdoor environments. Display shall have back light and contrast adjustment for easy viewing in bright sunlight or night conditions. The display module shall have raised surface buttons with positive tactile response.

d. The controller shall include a remote on-off interface to enable chiller/heater from the building control system. Chiller/heater shall also include outdoor air temperature shutdown which shall be set to disable the cooling mode at outdoor air temperatures below 58°F, disable the heating mode at outdoor air temperatures above 70° or below 0°.

e. The control system shall allow software upgrade without the need for new hardware modules.

f. BacNet card for EMS interface.

2. Safeties

a. Unit shall be equipped with thermistors and all necessary components in conjunction with the control system to provide the unit with the following protections:

1) Loss of cooler flow.
2) Loss of refrigerant charge.
3) Reverse rotation.
4) Low chilled fluid temperature.
5) Low oil pressure (each compressor circuit).
6) Voltage imbalance.
7) Ground current fault.
8) Thermal overload.
9) High pressure.
10) Electrical overload.
11) Loss of phase.
12) Current imbalance.

b. Fan motors shall have inherent overcurrent protection.

3. Diagnostics

a. The display module shall be capable of indicating the safety lockout condition by displaying the information in clear language at the display. Information included for display shall be:

1) Compressor lockout.
2) Loss of charge.
3) Low fluid flow.
4) Low oil pressure.
5) Cooler freeze protection.
6) High or low suction superheat.
7) Thermistor malfunction.
8) Entering and leaving-fluid temperature.
9) Evaporator and condenser pressure.
10) Electronic expansion valve positions.
11) All set points.
12) Time of day.

b. Display module, in conjunction with the microprocessor, must also be capable of displaying the output results of a service test. Service test shall verify operation of every switch, thermistor, fan, and compressor before chiller is started. User shall be able to force each output device.

c. Diagnostics shall include the ability to review a list of the 20 most recent alarms with clear language descriptions of the alarm event. Display of alarm codes without the ability for clear language descriptions shall be prohibited.

d. An alarm history buffer shall allow the user to store no less than 20 alarm events with clear language descriptions, time and date stamp event entry.

J. Operating Characteristics

1. Unit shall be capable of starting and running at outdoor ambient temperatures from 0° to 125 F.

2. Unit shall be capable of starting up with up to 95 F entering fluid temperature to the cooler in cooling mode and up to 130°F entering fluid temperature to the cooler in heating mode.

3. Special Features: Certain standard features are not applicable when the features designed by are specified. For assistance in amending the specifications, contact your Carrier Sales office.

K. Control Power Transformer

1. Unit shall be supplied with a field (or factory) installed transformer that will allow supply control circuit power from the main unit power supply.

2. Non-Fused Disconnect

a. Unit shall be supplied with factory-installed, non-fused electrical disconnect for main power supply.

L. Condenser Coil Materials

1. Pre-coated aluminum fin coils: Shall have a durable epoxy-phenolic coating to provide protection in mildly corrosive coastal environments. Coating shall be applied to the aluminum fin stock prior to the fin stamping process to create an inert barrier between the aluminum fin and copper tube. Epoxy-phenolic barrier shall minimize galvanic action between dissimilar metals.

M. Minimum Load Control

1. Unit shall be equipped with factory (or field) installed, microprocessor-controlled, minimum-load control that shall permit unit operation down to 10% capacity.

N. Security Guards

1. Unit shall be supplied with factory (or field) installed, PVC-coated grilles to protect the condenser, cooler, compressor and control and electrical components.

O. Low Ambient Protection

1. Unit shall have field-installed cooler and pump heaters, receiver, liquid line solenoid valves and pump-out cycle to protect unit from ambient temperature freeze down to 0° F.

P. Vibration Isolation

1. Vibration isolation pads shall be supplied for field installation at unit mounting points. Pads shall help to reduce vibration transmission into the occupied space.

2.24 HEAT EXCHANGER

A. General

1. Furnish as shown on the plans, a plate & frame style water to water/glycol heat exchanger as manufactured by Alfa Laval, Taco or Bell & Gossett.
2. The heat exchanger manufacturer shall have an established and on-going QA/QC program including manuals available for inspection at plant.
3. The heat exchanger manufacturer shall have extensive background and experience in the design and fabrication of shell & tube style heat exchangers. The manufacturer shall have fabricated shell & tube style heat exchangers for a minimum of twenty (20) years.
4. Heat exchanger shall have 150 psig ASME rated carbon steel shell and #304 stainless steel plates fully serviceable via a removable end.

B. REFERENCES

-ASME Section II - Material Specification
-ASME Section V - Non-Destructive Testing
-ASME Section IX - Welding and Brazing qualifications
-ASME Section VIII - Pressure Vessel Code
-ARI Standard 400 – Liquid to Liquid Heat Exchangers

C. CERTIFICATION

1. ARI Certification
Plate heat exchangers shall be certified according to ARI Standard 400 and listed on the ARI Prime Net site (www.ariprimenet.org). If heat exchanger is

not ARI certified, then the manufacturer shall provide an independent third party field performance test using the mapped ratings, limits and tolerances of ARI Standard 400 to verify performance to specification. Any and all cost associated with correcting a non-performing heat exchanger to meet the performance requirements shall be the responsibility of the supplier. Any cost associated with the field performance test shall be included in the price of the heat exchanger.

2. ASME Certification. Heat exchangers shall be designed, constructed, and tested in accordance with Section VIII, Division I of the ASME Pressure Vessel Code, and shall be code stamped.

D. WARRANTY

1. The warranty period shall be 3 years from date of shipment but no less than 1 year from substantial completion.

2.25 WATER STORAGE THERMAL BUFFER TANK

A. The water storage thermal buffer tank shall be Lochinvar model #BVU-300, 300 gallon factory insulated and jacketed vertical tanks or equal by AO Smith or WesTank. The steel tank shall have a channel iron skid mount. The tank shall be ASME constructed and designed for 150 PSI working pressure and equipped with a hand-hole for cleaning and inspection. The tank shall be insulated with 2” HCFC free foam insulation that completely surrounds the tank and shall be enclosed in a baked enamel steel jacket. The tank insulation is high density foam insulation and shall meet or exceed ASHRAE Standard 90.1. Tanks shall be ASME bearing the ASME Sec. VIII U Stamp and rated for 125 PSI working pressure. The tank shall be covered by a five (5) year limited warranty against leaks.

B. Provide top mounted automatic air vent taping with high capacity air vent and temperature/pressure relief valve. In addition, provide a 1” drain tapping with filed provided ball valve with hose bib connection, cap & chain.

C. Provide custom sized tappings with two (2) 4” flanged tappings on one side of tank for system water connection and two (2) 3” threaded tappings on the opposite side of the tank for the air to water heat pump connections.

2.26 THERMOMETERS AND PRESSURE GUAGES

A. Straight Thermometers:

1. Where indicated on the Drawings, furnish and install 7 in. long die-cast aluminum case, "Adjustable Angle" red appearing mercury tubing thermometers, H.O. Trerice Co., Cat. A001 complete with separable stainless steel Type 304 socket, 30 degrees to 240 degrees F. range, and lagging extensions when installed in insulated pipe.

2. Thermometers to be adjusted to a position for maximum readability from normal operator's position.

3. Thermometers shall be H.O. Trerice Co., Weksler Instruments Corp., Weiss Instruments, or approved equal.

B. Pressure Gauges: Pressure gauges shall be as manufactured by Trerice, or approved equal, Series 600, 4-1/2 in. diameter, range 0 to 100 PSI (or other range as required by application), aluminum case, white face with black figures, with petcocks. Provide fluid filled gauges at pumps.

C. Provide separable stainless steel wells for each thermometer and pressure gauge. Wells for thermometers shall be filled with heat conductive gel prior to installation of thermometer.

2.27 ELECTRICAL WORK

A. The Heating, Ventilating and Air Conditioning Contractor shall provide all wiring for the Automatic Temperature Controls, fuel oil system, fans, etc. except as otherwise specified herein.

B. The HVAC contractor shall hire a licensed electrician to perform all control wiring as required by code. Minimum gauge of all control wiring is 18 AWG plenum rated. HVAC contractor shall hire the project electrician to perform high voltage power wiring, interlocks, relays, etc. required for the HVAC controls. Control wiring shall be run in EMT conduit with flexible MC at connection to each unit.

C. The Electrical Contractor shall install and do all power wiring for all motor starters and unmounted motors, furnished to him at the job site by other trades.

D. For all low voltage motors, temperature control wiring and motor control wiring, including wiring for interlocking, shall be provided by the Section providing the motors, including the installation of all control devices.

E. Furnish all starters and all other motor control devices for motor driven equipment required for the work. The Electrical Contractor shall provide all code required disconnect switches for all motors, except where otherwise noted. The setting of all

motors required for mechanical equipment shall be included as part of the mechanical work.

F. Equipment which includes a number of correlated electrical control devices mounted in a single enclosure or on a common base with equipment, shall be supplied for installation completely wired as a unit with terminal boxes and ample leads ready for external wiring.

G. All electrical items called for as part of the mechanical work shall conform to NEMA Standards, to the requirements of the National Fire Protection Association and to the requirements of any local electrical code authority having jurisdiction, any field modifications required to ensure such conformance shall be included as part of the mechanical work.

2.28 ELECTRIC MOTORS

A. This Contractor shall provide all electric motors necessary for driving all motor driven equipment required to be furnished under this section of the Specifications.

B. All motors shall be designed for 3 phase, 60 cycle alternating current operation with 208 volts across the motor terminals, except that, unless otherwise specified herein, all motors 1/3 HP and smaller shall be designed for single phase, 60 cycle alternating current at 120 volts across the terminals.

C. The speed, horsepower, type and other essential data for each motor, if not given under paragraphs describing the various motor driven apparatus, or in schedules on the drawings shall be submitted to the Engineer for his review. All two speed motors shall be single winding type.

D. Contractor shall furnish premium efficient motors for all motors over ½ HP for eligibility for rebate by the local electric utility.

2.29 AUTOMATIC TEMPERATURE CONTROLS

A. Furnish and install all control components necessary to obtain a fully functional control system as described herein. The contractor is responsible for providing all controls, relays, etc. necessary to accomplish the Sequence of Operations and performance specified, whether or not the items are specifically identified herein. This shall include all the points shown in the control diagrams and on the drawings. Wherever a setpoint is referred to, this implies that the setting is adjustable by the user. Contractor shall hire the project electrician to provide additional power supplies to support the control devices as required. All controls operating equipment and

systems configured to run off emergency power must be wired to the emergency power circuit. This shall include but not be limited to 1) front-end work station, 2) network controllers and interface, 3) boiler plant (boilers, pumps, ventilation, CO system), 4) IDF and MDF cooling systems, 5) fin-tube radiation, 6) cabinet unit heaters & unit heaters and 7) VRF system. Provide battery UPS power supplies for the front-end and network interface controls to insure no interruption of the power supply.

C. The specified DDC system is based on the most recent generation of products from Honeywell or Johnson Controls (FX series) most current edition capable of being installed and serviced by at least two competitive factory authorized vendors within a 50 mile radius of the project site. The control system shall operate on a central network bus and shall web based access via password protection to any remote computer. This control system shall be referred to as the DDC, EMS or ATC system throughout this specification. EMS system must be Bacnet and Open Protocol compatibility for direct communication with the VRF system and the chiller/heater to obtain operation status of systems including real time energy consumption. Besides various HVAC systems the EMS shall communicate to other building systems via ModBus RS-485 connection to monitor and report on status and energy use. The systems shall be as follows:
   - Generator (Modbus RS-485) – for monitoring various generator functions.

D. The BMS contractor shall be regularly engaged in the installation and maintenance of BMS systems and shall meet the following qualifications:

   1. A minimum of ten (10) years of demonstrated technical expertise and experience in the installation and maintenance of BMS systems similar in size and complexity to this project.
   2. A minimum of ten (10) years experience installing the control system of the manufacturer that is to be proposed.
   3. Shall be a certified-to-install, direct representative of a control system manufacturer that has a minimum of ten (10) years experience producing control systems similar to that which is to be proposed.
   4. A maintained service organization consisting of at least eight (8) competent servicemen, within 60 miles of the project site, for a period of not less than ten years.
   5. Tech support available 24 hrs / per 365 day's per year.
   6. The Bidder shall not be considered qualified to bid this project unless they can provide a list of 10 projects, similar in size and scope to this project, completed within the last four years.

7. The system manufacturer/installer shall provide an experienced project manager for this
work from beginning of control installation until final completion. The project manager
is responsible for direct supervision of the design, installation, start-up and commissioning of the BMS as well as attending of project meetings whenever directed by the owner, construction manager, and/or mechanical contractor. It shall not be acceptable to change the project manager after the project has begun and before final completion. If the BMS manufacturer wishes to change the project manager, the construction manager and/or owner's representative must be notified immediately and both the new project manager and the previous project manager shall spend 3 consecutive business days together on-site performing a project management switchover. Exceptions may be allowed for small projects as determined by the construction manager and/or owner's representative

E. The entire system, materials & devices as well as installing contractor and associated work shall comply with all current governing codes, ordinances and regulations including UL, NFPA, NEC, IBC, IMC, local AHJ, etc…

F. The system shall have a documented history of compatibility by design for a minimum of 15 years. Future compatibility shall be supported for no less than 10 years. Compatibility shall be defined as the ability for any existing control system component including but not limited to Primary Control Panels, Secondary Control Panels, personal operator workstations, and portable operator's terminals, to be connected and directly communicate with any new BMS system equipment without bridges, routers or protocol converters.

G. All control wiring shall be shielded plenum rated minimum 18 AWG (unless lighter gauge or heavier gauge is required due to impedance or current demands) and shall be run concealed above ceilings or within walls. When the wiring must run exposed it shall be run in EMT conduit in unfinished service spaces and in Wiremold® or equal conduit system product in finished occupiable spaces.

H. It shall be division 23 00 00 responsibility to provide all personnel as required to fully coordinate with the commissioning agent. The hours of training and instruction outlined in division 23 00 00 and the Testing and Balancing requirements shall be in addition to those tests and requirements outlined in section 01 91 00 and required to fulfill section 01 91 00 commissioning obligations.

I. General

1. The automatic temperature control system shall include, but not be limited to, the following components:

- Front-end computer with graphic software showing all building HVAC systems. Real-time interface with controlled components.
- Several stand-alone DDC control unit(s) networked together on a local LAN to control the environment in the entire building
- Expansion modules for the controllers, if required, shall provide for the capability of additional DDC points.
- End devices such as sensors, actuators, dampers and valves.
- Control transformers and relays.
- Control wiring between duct smoke detectors and the respective fan starters.

2. The failure of any single component shall not interrupt the control strategies of other operational devices.

J. OPERATOR INTERFACE / STATION

1. Provide one main Front-end workstation which shall include the following:
   - Windows operating system compatible computer with Intel 8th Generation Core i5 processor (or equal AMD) 2.8 gigahertz speed.
   - 1 TB Hard Drive
   - 8 GB RAM
   - Dedicated Intel UHD 630 graphics Card (or equal AMD) and 22" flat screen color monitor
   - Keyboard
   - 48X CD-ROM/ REWRITE drive
   - 2 button mouse with scroll wheel
   - 10/100/1000 Ethernet Network Card
   - Wireless Card
   - Windows 10 software (or other as required by EMS)
   - Color Ink Jet Printer
   - 2 cartons of 1000 sheets bright white ink jet paper
   - Software including: dynamic color graphics; database creation and support; password access levels; alarm processing; data collection and trending; etc..
   - Back-up discs or USB storage devices of all software and programming.

K. INPUT/OUTPUT INTERFACE

1. Digital Inputs (DI) shall allow the monitoring of on/off signals from remote devices. The digital inputs shall provide a wetting current of 12mA at 12 vdc to be compatible with commonly available control devices.

2. Analog Inputs (AI) shall allow the monitoring of low voltage current or resistance signals and shall have a minimum resolution of 0.1% of the sensing range. Analog inputs shall be compatible with and field configurable to commonly available sensing devices.

3. Digital Outputs (DO) shall provide a continuous low voltage signal for on/off control of remote devices. Where specified in the sequences of operations or indicated on the points list, digital outputs shall have 3-position (on/off/auto) override switches, status lights, and shall be selectable for either normally open or normally closed positions.

4. Analog Outputs (AO) shall provide a modulating signal for the control of end devices. Outputs shall provide either a 0 to 10vdc or a 4 to 20 mA signal as required to provide proper control of the output device.

L. AUXILIARY CONTROL DEVICES

1. Control Valves

   a. Valve bodies shall be 2-way or 3-way mixing as shown on the drawings and as specified herein. Valve bodies 2" and under shall be bronze, screwed type, rated for 125 psig. Valve bodies 2-1/2" and over shall be iron, flanged and rated at 125 psig, except where otherwise noted. Valves shall have stainless steel stems and allow for servicing including packing, stem and disk replacement. Valve shall be sized for a pressure drop equal to 2 psig.

2. Valve Actuators

   a. Valve actuators shall be electronic, spring return, low voltage (24v) and properly selected for the valve body and service. Actuators shall be fully proportioning. All heating valves including radiation shall be fail open style to open fully upon power loss however, during summer months when the heating plant is off, power to the valves shall be disabled as well.

3. Dampers and Actuators

   a. Dampers shall be opposed blade type except where installed in round ductwork where single blade type is acceptable. All damper blades shall be low leakage type with neoprene gasketed edge seals rated for no more than 3CFM/SF leakaeg at 1" w.g.. Actuators shall be electronic, spring return, low voltage (24v) and properly selected for the required torque and speed. Actuators shall be fully proportioning with the exception of those dampers specified as being 2-position open & closed.
   b. Dampers exposed to the area served shall be double wall insulated ultra-low leakage type.

4. Temperature Sensors

a. Temperature sensors shall be Resistance Temperature Detector (RTD) type or thermistors, as dictated by the requirements of this specification. Final location of all space sensors shall be coordinated with the Owner and Engineer. Space sensors in offices and other non-public spaces shall be wall mounted type with a user adjustable access allowing deviation of +/- 3 deg. of computer defined setpoint and push button occupied override. Space sensors in Shop and Garage areas shall be non-adjustable type with push button occupied override. Sensors in vehicle wash bay shall be stainless steel plate type.

b. Duct sensors shall be rigid or averaging as specified in the sequence of operations. Averaging sensors shall be a minimum of 20 feet in length. Freeze protection sensor shall have a 20 foot sensor crossing back and forth across the air exit face of the water heating coil. Immersion sensors shall be provided with a separable stainless steel well

c. Sensor accuracy's and operating ranges shall be as follows:
   - Space temp. +/- 1 deg. F, 0 to 130 deg. F range
   - Duct temp. +/- 1 deg. F, 30 to 160 deg. F range
   - O.A. Duct temp. +/- 1 deg. F, -30 to 160 deg. F range
   - Water +/- 1 deg. F, 0 to 200 deg. F range

5. Relative Humidity Sensors

   a. Relative humidity sensors shall be thin film capacitor type with an accuracy of +/- 2% with a range of 10% to 90%. For enthalpy calculations provide on North wall for outdoor air sensing and one in each AHU main return air duct and elsewhere as shown on the control drawings or indicated herein. Final location of all space sensors shall be coordinated with the Owner and Engineer. Space sensors shall be wall-mounted type.

6. CO2 sensors: Shall be self-calibrating duct or wall-mounting type as specified capable of measuring a CO2 range between 100 and 2000 PPM as manufactured by Mamac or approved equal.

7. Flow Switches

   a. Differential pressure switches shall be provided at filters and fans. Paddle type switch shall be provided at boilers and chiller/heaters unless otherwise noted. Current sensing run indicators shall be provided at each fan and pump. Sensor shall be able to differentiate between belt loss and motor failure and report to the workstation as such.

8. Air Flow Measuring Stations: Provide multi-point cross grid hot wire flow measuring station at outdoor air duct main on each ERV. Device shall be similar to Ebtron Gold series.
9. Water Flow Measuring Stations: Provide ultrasonic water flow measuring stations in the mains of the hot water system and the chiller heater to calculate system GPM flow (and BTU data via temp. sensors) with +/- 2% accuracy across full range of flow from maximum to a minimum flow rate of 15% of maximum.
10. Duct Smoke Detectors: HVAC contractor shall install duct smoke detectors in ductwork as well as interlock with respective fan circuits and EMS system. Electrical contractor shall furnish duct smoke detector, power wire and wire to fire alarm system.
11. Occupancy Sensors: Provide dual technology (PIR and Ultrasound) occupancy sensors for EMS monitoring and control of HVAC ventilation systems in the Vehicle Repair Garage #122, Shops #117 and Wash Bay #124. Sensors shall be as manufactured by Wattstopper or equal. Sensors shall be in a number and location to cover all occupiable spaces of the respective areas. Occupancy sensors provided by the electrical contractor in the Office spaces shall be furnished with a spare contact for monitoring by the EMS.
12. Furnish and install a CO detection and alarm system in boiler plant. The system shall consist of a central control/annuciator panel and a remote CO sensor as shown on the drawings. The system shall communicate with the building EMS. System shall be as manufactured by Toxalert, Viking or MSA. CO sensor shall have solid state sensing element with a 0-400 ppm range, 10-year warranty, automatically calibrating, Toxalert model TOX-CO/ANA with controller model ToxControl. System shall automatically compensate for temperature and send a 0 to 10vdc and digital signal to the building EMS for control of ventilation and monitoring. Provide NEMA 1 enclosure, status lights, 85 dB audible alarm and visual strobe. EMS shall provide all wiring between sensor, panels, alarms, fans, EMS, etc…

M. OPERATOR INTERFACE SOFTWARE

1. Alarms

   a. The stand-alone DDC unit shall provide visual notification of equipment failures, program failures, hardware failures or sensor failures. In addition each sensor and point shall be individual alarmed for values in excess of their respective high/low limits or status. When an alarm is detected, it shall be automatically stored and the user notified by displaying a message on the front display panel. The front-end shall be located in the Maintenance Office.

b. In addition to visual notification, an audible alarm shall sound during a high-level alarm condition as follows:
   - Duct smoke detector activated
   - Fan failure
   - Pump failure
   - Boiler failure
   - Freeze protection alarm
   - CO alarm
   - Low space temperature (lower than 50°F)
   - High space alarm (greater than 100°F)
   - Freezer and Refrigerator temperature alarms

c. The audible alarm shall be mounted in a location as directed by the Owner. A toggle switch or push button shall be mounted adjacent to the alarm with a laminated plastic tag noting "HVAC Alarm: Silence – Auto". Once alarm condition subsides the alarm shall be automatically reset. This alarm shall be in addition to those local alarms provided for CO & Refrigerant alarms.

2. Scheduling

   a. The scheduling program in the stand-alone DDC unit shall provide daily, weekly and calendar scheduling capability. The master schedule shall be capable of being individually edited for each day of the week and holidays.

3. Communications

   a. The controller shall communicate on a network bus. In addition, the system shall communicate to the internet via a Ethernet connection. Coordinate with Owner for Ethernet interface port. Contractor shall program system to dial out and email alarms to predefined parties and send alarms to the Owner's security monitoring company.

4. Energy Monitoring

   At the Owner's workstation provide software and graphically trends as required to display system operational status and energy consumption of boilers, RTU's, air handlers, system BTU loads, lighting power consumption and solar power Watt energy generation. Graphs shall report energy consumption/generation in BTU, Watts and kW over time.

   Energy data from the HVAC equipment and system shall be derived from the applicable fan and pump VFD drive kW information as well as BTU data from the airflow and water flow stations and applicable temperature and humidity

sensors (humidity sensors used for airflow BTU energy). In addition, the EMS shall provide monitoring devices to track the natural gas consumed by the domestic hot water heaters and the heating boilers on a real time and totalized basis using pulse metering retrofitted to gas sub meters. The gas meters shall be furnished and installed by the plumbing contractor and the pulse meters shall be installed by the control contractor. Plumbing contractor shall install gas sub meters on the main gas line to the boiler plant and the branch gas line to the domestic water heaters. Heating boiler gas usage shall be determined by subtracting the domestic water heater gas meter reading from the boiler plant gas meter reading. The pulse meters shall be similar to the 'X'-pulser manufactured by IMAC Systems, Inc. compatible with the gas meter furnished by the plumbing contractor

Besides various HVAC systems the EMS shall communicate to other building systems via ModBus RS-485 connection to monitor and report on status and energy use. The systems shall be as follows:

- Lighting system (BACNet) – for occupancy/vacancy status of each room.
- Generator (Modbus RS-485) – for monitoring various generator functions.
- Submetering (Modbus RS-485) – for monitoring loads for each meter, some of which will have to be manipulated, and then displayed as graph or data.

The system shall be fully capable of being programmed to load shed the DX cooling of various systems based on maintaining building kW demand below a preset limit. Unless otherwise directed as a minimum the programming shall prioritize the DX cooling drop as follows: 1st Drop Gym cooling, 2nd Drop kitchen cooling 3rd Drop Café cooling. Further system shedding shall be reviewed with Owner.

5. Generator Monitoring:

   a. Integration to Building Management System (BMS):

      1) Electrical contractor shall provide Modbus RS-485 communications wiring from the generator to:
         - BMS system.
         - Generator Annunciator.

      2) The BMS system shall monitor the following points:
         - Overcrank shutdown
         - Low coolant temperature warning
         - Pre-warning for high engine temperature
         - High engine temperature shutdown
         - Pre-warning for low lube oil pressure
         - Low lube oil pressure shutdown

- Overspeed shutdown
- Low fuel in main tank warning
- Low coolant level warning
- Generator (EPS) supplying load.
- Generator control switch not in auto position warning
- High battery voltage warning
- Low cranking voltage warning
- Low battery voltage warning
- Battery charger failure
- Generator output breaker(s) open warning
- Emergency stop depressed
- Load Bank Connected
- Load Bank Over-Temperature
- Load Bank Load Dump
- Permanent generator Disconnected/Portable Generator (signal from manual transfer switch)
- Spare/Customer alarm
- Spare/Customer alarm

b. The electrical contractor shall provide wiring from the BMS system to the generator for the load bank "transfer of control" contact closure to initiate the load bank and time delay load application circuit.

c. The electrical contractor shall provide wiring from the generator to the BMS for indication, detection and alarm of Load Bank Over-Temperature and Load Dump.

d. Coordinate exact requirements with the electrical vendor.

6. Filter Alarms:

   If filter differential static pressure sensor detects a filter pressure drop of greater than a setpoint of 0.7" a dirty filter maintenance alarm shall be reported by the front-end. Typical for all system with filter monitoring as indicated on the control drawings.

N. CARBON MONOXIDE / NITROUS OXIDE DETECTION SYSTEM

1. The system shall provide Carbon Monoxide & Nitrous Oxide Detection within the Garage and Service Area for control or ventilation fans and Outside Air Intake Louvers through the EMS and to provide an alarm signal when a hazardous level of CO or NOx is detected.

The Carbon Monoxide / Nitrous Oxide Detection System shall consist of one central control/annunciator panel with integral horn & strobe light, multiple remote CO sensors, multiple remote NOx sensors and multiple remote fuel gas sensors FG. It is the intent that the panels shall report conditions to the EMS which shall enable fans and alarms.

2. ACCEPTABLE MANUFACTERS

   a. Manufactures shall have local representation experienced with Carbon Monoxide Detection Systems and minimum of ten (10) continuous years of active service. A local supply of spare parts and authorized factory repair service shall be available.

   b. List of Manufactures:

      a. Toxalert, Inc.
      b. Vulcain.
      c. Honeywell.
      d. Approved equal.

   3. Specification has been based around Toxalert.

3. CARBON MONOXIDE SENSORS (CO) & NITROGEN OXIDE SENSORS (NOx)

   1. The CO and NOx sensors shall output a linear 4 to 20 ma analog signal proportional to the CO or NOx gas levels detected to the controller and shall have a normal operation range of –20 deg. F. to 122 deg. F. and 0 to 95%R.H. non-condensing. The sensor shall have a range of 0 to 250 PPM for CO and 0 to 10 for NOx, with an accuracy of +/- 3% of range. The sensors shall be microprocessor based with twelve (12) bits analog/digital resolution and periodically recalibrate itself.

   2. The CO and NOx sensors shall have a solid-state sensing element for life of ten (10) years and shall be microprocessor based and be self-monitoring of proper operation. The temperature thermistor will automatically compensate the output signal for changes in ambient relative humidity and temperature.

   3. The CO and NOx sensors shall have indicators for: 1) power on; 2) automatic calibration/operating properly; 3) sensor malfunction; 4) high CO or NOx alarm.

   4. The sensor enclosure shall be a NEMA 1 removable hinged cover cabinet, with a keyed lock to prevent tampering. An aluminum splash/dust shield on the face of sensor to protect sensing element.

   5. The sensor shall be powered by 24 VAC, 4 wire, 18 gauge shielded.

6. Sensors shall be located as indicated on the drawing(s).

7. Carbon monoxide sensor shall be a model TOX-CO/ANA as manufactured by Toxalert, Inc.

8. Notrogen Oxide/Dioxide sensor shall be a model TOX-NO2/ANA as manufactured by Toxalert, Inc.

4. CONTROLLER/ANNUNCIATOR

1. Provide a controller to monitor all sensors. The controller shall contain power supplies, solid-state control logic, amplifiers, and output to start and stop the ventilation fans. The controller shall be designed to be wall mounted for visual and audible alarm indication. Integrate all controllers to EMS for monitoring and fan control.

2. The controller shall be microprocessor based and utilize battery back-up to ensure system programs are not lost during power interruption.

3. Fan ON delays can be programmed from one (1) to ninety-nine (99) seconds. Power input to control panel should be 120V/1PH/60HZ.

4. The controller and sensors shall be mounted as shown on drawings.

5. Provide labeled indictors on the face of the controller panel for 1) power ON, 2) high CO level, 3) NOx level, 4) fan ON; and 5) power to each sensor.

6. Provide an audible alarm for each sensor with a sound level minimum of 85 db. Also, provide a momentary pushbutton to silence the audible alarm. The visual alarm indicator shall remain lighted as long as the alarm condition persists even though the audible signal has been silenced.

7. The controller shall have all the necessary power supplies and transformers to supply power to CO and NOx sensors.

5. CONDUIT AND WIRE

1. Conduit and wiring shall be as indicated on the plan(s) and meet all local and national codes. Signal wiring shall be a minimum size of #18 AWG for sensors.

2. All wiring shall run in EMT conduit. Provide weatherproof conduit in exterior locations and in the wash bay.

6. INSTALLATION

    1. This contractor shall provide all conduit, wiring, and junction and outlet boxes as required for a complete system.

    2. Electrical contractor shall provide 120 VAC power to the CO detection system.

7. TESTS AND ADJUSTMENTS

    1. A representative of the manufacturer shall be present with the contractor to check out and start up the system per manufacturer recommendations.

    2. Perform an actual CO and NOx system test using CO and NOx gas cylinders. The test will be witnessed by the engineer and other interested parties.

L. SEQUENCE OF OPERATION – Variable Refrigerant Flow Zoning System - VRF (HP-# & FC-#):

    1. The fan coil zones shall cycle their fans and heat pump unit for cooling or heating as required to maintain scheduled space temperature setpoint initially set for 72°F occupied & 62°F unoccupied for heating and 75°F occupied and 88°F unoccupied for cooling. During scheduled occupied periods or if the respective fan coil is placed in temporary occupied mode the fan coil fan shall operate continuously and a signal shall be sent to the respective ERV to enable (see ERV sequence herein).
    2. The fan coil fan shall operate on low speed when room conditions have met setpoint and shall speed up as needed when space demand requires either cooling or heating. In unoccupied rooms the fan shall be allowed to cycle off until such time as occupancy is realized or if space cooling or heating is required.
    3. If the system is in a scheduled occupied state but an area is unoccupied as determined via monitoring of the lighting occupancy sensor (sensors shall have spare contacts for HVAC use), the respective fan coil fan shall be allowed to cycle off and cycle to maintain occupied setpoint temperatures. If the room becomes occupied the fan shall run continuous.
    4. If a fan coil unit with integral condensate drain pump detects an overflow condition in the condensate pump well, the fan coil cooling cycle shall be disabled and an alarm shall be reported to the front-end.
    5. The EMS system shall monitor space temperatures and send control signal to the VRF thru the BacNet interface. Each fan coil also requires a factory temperature sensor be mounted in the space adjacent to the EMS sensor.
    6. Points List: Refer to the plans and these sequences of operation and provide all points required and inferred to make for a fully functional and operation system. Being that the unit shall be BacNet compatible various points may be extracted

from the interface however this contractor must provide any and all points needed to achieve the operation and monitoring level specified. As a minimum, the following points will be monitored and controlled for each fan coil unit.

Inputs	Outputs
Space temp. AI	Fan Coil Fan S/S DO (mult. speed)
Space temp. adj AI	Fan Coil Cooling S/S DO
Push button override DI	Fan Coil Heating S/S DO
Heat Pump Alarm DI	
Supply Air Temp AI	
Lighting Occupancy Sensor DI	
Condensate Pump Alarm DI	
VRF space sensor (to VRF)	

M. SEQUENCE OF OPERATION – ENERGY RECOVERY UNIT (ERV-1):

1. General

   a. ERV-1 is a constant volume energy recovery units which provides year-round ventilation to the Vehicle Storage Garage. The unit comes with some integral factory controls as well however, full interface and control as specified herein is the responsibility of the mechanical and controls contractor.

2. Supply and Exhaust Fan Control

   a. The EMS shall enable the system to run 24 hours per day 7 days per week. Enable/disable control and status of fans shall be reported by the EMS.

3. Operating Mode

   a. The outdoor air and exhaust air dampers shall open when the unit is commanded on by the EMS.

   b. Supply and exhaust fans shall run continuous when commanded on.

   c. The hot water coil valve shall modulate as required to maintain the supply air temperature at a setpoint equal to that of the garage heating setpoint but no less than 50°F.

   d. If discharge air temperature (upstream of hot water coil) or supply air temperature (downstream of the hot water coil) falls below 42°F for longer than 60 seconds the ERV unit shall be disabled, dampers shall close and a freeze warning shall be reported by the EMS.

e. If freeze stat located downstream of the hot water coil falls below 38°F for longer than 30 seconds the ERV unit shall be disabled, the hot water coil valve shall open 100%, the dampers shall close and a freeze alarm shall be reported by the EMS.

f. Unit shall cycle exhaust only defrost control based on a factory provided defrost sequence. In general, defrost should not need to occur until OA temperatures are below 5°F.

4. DDC Point List – Energy Recovery Unit ERV-1

a. Refer to the plans and these sequences of operation and provide all points required and inferred to make for a fully functional and operation system. As a minimum the following points being monitored and controlled for each unit:

Inputs	Outputs
O.A. temperature AI (global)	Supply fan S/S DO (or 0-10Vdc)
O.A. humidity AI (global)	Exhaust fan S/S DO (or 0-10Vdc)
Supply fan status amp. switch DI	E.A. damper DO
Exhaust fan status amp. switch DI	O.A. damper DO
Discharge air temperature AI	HW Coil Valve AO
Supply Air Temperature AI	
Coil Freeze Stat DI	
Return/Exhaust Air Temperature AI	
SA Filter DP DI	
EA Filter DP DI	
Space Occupancy From FC Zone DI (multiple)	

N. SEQUENCE OF OPERATION – ENERGY RECOVERY UNIT (ERV-2):

1. General

a. ERV-2 is a constant volume energy recovery units which provides year-round ventilation of the Vehicle Service Garage. The unit comes with some integral factory controls as well however, full interface and control as specified herein is the responsibility of the mechanical and controls contractor.

3. Supply and Exhaust Fan Control

a. The EMS shall index from the occupied mode to the unoccupied mode based on a time schedule furnished by the owner. This schedule may be temporary overridden for a predetermined time period by push button override switches on the space thermostats. When overridden, the system will run in occupied

mode for a 2-hour (adj.) time period. Enable/disable control and status of fans shall be reported by the EMS.

3. Occupied Mode

    a. When in the occupied mode the system shall remain in standby and shall only operate if the space occupancy sensors detect occupancy or the space CO/NO system detects a low or high level alarm condition.

    b. Once enabled, the outdoor air and exhaust air dampers shall open and the supply and exhaust fans shall run. When enabled the system shall operate until the occupied or alarm condition has subsided for longer than 5 minutes.

    b. The hot water coil valve shall modulate as required to maintain the supply air temperature at a setpoint equal to the space heating setpoint minus a 2° deadband but in no case less than 55°F.

    c. If discharge air temperature (upstream of hot water coil) or supply air temperature (downstream of the hot water coil) falls below 45°F for longer than 60 seconds the ERV unit shall be disabled, dampers shall close and a freeze warning shall be reported by the EMS.

    d. If freeze stat located downstream of the hot water coil falls below 38°F for longer than 30 seconds the ERV unit shall be disabled, the hot water coil valve shall open 100%, the dampers shall close and a freeze alarm shall be reported by the EMS.

    e. Unit shall cycle exhaust only defrost control based on a factory provided defrost sequence. In general, defrost should not need to occur until OA temperatures are below 5°F.

4. Unoccupied Mode

    a. If the system goes into an unoccupied mode the ERV shall be disabled and its respective outdoor air damper shall close. The system shall be enabled is the space CO/NO/FG alarm system goes into low or high level alarm and operate until the condition has subsided for longer than 5 minutes.

5. DDC Point List – Energy Recovery Unit ERV-2

    a. Refer to the plans and these sequences of operation and provide all points required and inferred to make for a fully functional and operation system. As a minimum the following points being monitored and controlled for each unit:

Inputs	Outputs
O.A. temperature AI (global)	Supply fan S/S DO
O.A. humidity AI (global)	Exhaust fan S/S DO
Supply fan status amp. switch DI	Supply fan Speed AO
Exhaust fan status amp. switch DI	Exhaust fan Speed AO
Discharge air temperature AI	E.A. damper DO
Supply Air Temperature AI	O.A. damper DO
Coil Freeze Stat DI	CO/NO/FG Low & High Alr. DO (2)
Return/Exhaust Air Temperature AI	HW Coil Valve AO
SA Filter DP DI	
EA Filter DP DI	
CO Alarm Low and High DO (2)	
Fuel Gas Alarm Low and High (2)	
Space Occupancy (multiple)	

O. SEQUENCE OF OPERATION – ENERGY RECOVERY UNIT (ERV-3):

1. General

   a. ERV-3 is a constant volume energy recovery units which provides year-round ventilation to the fan coil systems serving the office and locker room spaces. The unit comes with some integral factory controls as well however, full interface and control as specified herein is the responsibility of the mechanical and controls contractor.

4. Supply and Exhaust Fan Control

   a. The EMS shall index from the occupied mode to the unoccupied mode based on a time schedule furnished by the owner. This schedule may be temporary overridden for a predetermined time period by push button override switches on the space thermostats. When overridden, the system will run in occupied mode for a 2-hour (adj.) time period. Enable/disable control and status of fans shall be reported by the EMS.

3. Occupied Mode

   a. The outdoor air and exhaust air dampers shall open when the FC systems served by the unit enter the occupied mode as determined by system schedule or occupied override switch.

   b. Supply and exhaust fans shall run continuous during occupied periods.

   c. The hot water coil valve shall modulate as required to maintain the supply air temperature at a setpoint reset between 55°F and 65°F based on average space

temperature. Supply air shall be at its minimum of 55F when the average space temperatures are at or above 75°F and 65°F when the average space temperatures are at or below 70°F

d. If discharge air temperature (upstream of hot water coil) or supply air temperature (downstream of the hot water coil) falls below 45°F for longer than 60 seconds the ERV unit shall be disabled, dampers shall close and a freeze warning shall be reported by the EMS.

e. If freeze stat located downstream of the hot water coil falls below 38°F for longer than 30 seconds the ERV unit shall be disabled, the hot water coil valve shall open 100%, the dampers shall close and a freeze alarm shall be reported by the EMS.

f. Unit shall cycle exhaust only defrost control based on a factory provided defrost sequence. In general, defrost should not need to occur until OA temperatures are below 5°F.

4. Unoccupied Mode

a. If the system goes into an unoccupied mode the ERV shall be disabled and its respective outdoor air damper shall close.

5. DDC Point List – Energy Recovery Unit ERV-3

a. Refer to the plans and these sequences of operation and provide all points required and inferred to make for a fully functional and operation system. As a minimum the following points being monitored and controlled for each unit:

Inputs	Outputs
O.A. temperature AI (global)	Supply fan S/S DO (or 0-10Vdc)
O.A. humidity AI (global)	Exhaust fan S/S DO (or 0-10Vdc)
Supply fan status amp. switch DI	E.A. damper DO
Exhaust fan status amp. switch DI	O.A. damper DO
Discharge air temperature AI	HW Coil Valve
Supply Air Temperature AI	
Coil Freeze Stat DI	
Return/Exhaust Air Temperature AI	
SA Filter DP DI	
EA Filter DP DI	
Space Occupancy From FC Zone DI (multiple)	

P. SEQUENCE OF OPERATION – ENERGY RECOVERY UNIT (ERV-4):

1. General

    a. ERV-4 is a constant volume energy recovery units which provides year-round ventilation of the Shops area. The unit comes with some integral factory controls as well however, full interface and control as specified herein is the responsibility of the mechanical and controls contractor.

5. Supply and Exhaust Fan Control

    a. The EMS shall index from the occupied mode to the unoccupied mode based on a time schedule furnished by the owner. This schedule may be temporary overridden for a predetermined time period by push button override switches on the space thermostats. When overridden, the system will run in occupied mode for a 2-hour (adj.) time period. Enable/disable control and status of fans shall be reported by the EMS.

3. Occupied Mode

    c. When in the occupied mode the system shall remain in standby and shall only operate if the space occupancy sensors detect occupancy.

    d. Once enabled, the outdoor air and exhaust air dampers shall open and the supply and exhaust fans shall run.

    b. The hot water coil valve shall modulate as required to maintain the supply air temperature at a setpoint equal to the space heating setpoint minus a 2° deadband but in no case less than 55°F.

    c. If discharge air temperature (upstream of hot water coil) or supply air temperature (downstream of the hot water coil) falls below 45°F for longer than 60 seconds the ERV unit shall be disabled, dampers shall close and a freeze warning shall be reported by the EMS.

    d. If freeze stat located downstream of the hot water coil falls below 38°F for longer than 30 seconds the ERV unit shall be disabled, the hot water coil valve shall open 100%, the dampers shall close and a freeze alarm shall be reported by the EMS.

    e. Unit shall cycle exhaust only defrost control based on a factory provided defrost sequence. In general, defrost should not need to occur until OA temperatures are below 5°F.

4. Unoccupied Mode

a. If the system goes into an unoccupied mode the ERV shall be disabled and its respective outdoor air damper shall close.

5. DDC Point List – Energy Recovery Unit ERV-4

a. Refer to the plans and these sequences of operation and provide all points required and inferred to make for a fully functional and operation system. As a minimum the following points being monitored and controlled for each unit:

Inputs	Outputs
O.A. temperature AI (global)	Supply fan S/S DO (or 0-10Vdc)
O.A. humidity AI (global)	Exhaust fan S/S DO (or 0-10Vdc)
Supply fan status amp. switch DI	E.A. damper DO
Exhaust fan status amp. switch DI	O.A. damper DO
Discharge air temperature AI	HW Coil Valve AO
Supply Air Temperature AI	
Coil Freeze Stat DI	
Return/Exhaust Air Temperature AI	
SA Filter DP DI	
EA Filter DP DI	
Space Occupancy (multiple)	

Q. SEQUENCE OF OPERATION - ELECTRIC CABINET HEATER

1. Units integral thermostat shall enable and disable electric cabinet heater as required to maintain space occupied 60°F setpoints. EMS shall monitor space temperature and report an alarm if space falls below 55°F.

2. Points List

a. As a minimum, the following points will be monitored and controlled for each ECH Unit. See also points indicated on drawings:

Inputs	Outputs
Space temp. AI	

R. SEQUENCE OF OPERATION – HYDRONIC HEATING BOILERS & BOILER PUMPS

1. The hydronic oil-fired boiler/burner units shall be controlled by the EMS in conjunction with their factory safeties. All boiler/burner control wiring from burner control panels primary controls, operating controls, limits, switches, and additional control devices as required shall be furnished and installed by

the Automatic Temperature Control Contractor per manufacturer's instructions.

2. The boilers shall be second stage to the chiller/heater heat pump CH-1. Refer to CH-1 Sequence for additional information. CH-1 shall not be operated upon a call for domestic hot water heating.

3. HWB-1 & HWB-2 shall be staged and sequence to achieve the desired supply water temperature setpoint with a 5°F (adj.) deadband. Boilers system shall be enabled when the system pumps are on and the system is in the heating mode. In general, the boiler plant shall be enabled at outdoor temperatures below 65 degrees F. Boilers shall stage as required to maintain the boiler primary loop supply temperature at a setpoint of 160°F. Upon a call for domestic hot water via the tank aquastat the boiler supply loop temperature shall be reset to 180°F until such time as the domestic hot water demand is met. Boilers shall operate in lead/lag order and sequence to insure even run time.

4. Combustion air dampers shall open and prove open prior to allowing the boiler to fire. Combustion air dampers shall also open if the room temperature exceeds a cooling setpoint of 85°F and close once room drops below 80°F.

5. The hot water system mixing valve shall modulate hot water supply temperature off of outdoor air temperature reset as follows:

O.A.Temp	Supply Temp.
10°F or less	130°F
60°F	105°F

In addition, the mixing valve shall control to insure the return water temperature to the boilers does not fall below a setpoint of 140°F to avoid condensation and thermal shock.

6. When a boiler is called to fire its respective boiler pump shall enable and prove on prior to the boiler firing. When a boiler is disabled the respective pump shall operate 30 seconds to purge the boiler of hot water. Whenever the system is in heating mode and the CH-1 cannot maintain the heating demand at least one lead boiler pump shall remain on at all times.

7. Provide one (1) remote shutoff switch for the boiler room. Switch shall be located just outside the interior door to the boiler room. Switch must be located in a break glass or equal tamper resistant enclosure properly labeled. Switches must be wired and programmed so that when switch is placed in the off position a disable signal shall be immediately sent to all of the heating boilers.

7. DDC Point List - Hydronic Boiler Control

   As a minimum, the following points shall be hard wired monitored and controlled.

Inputs:	Output
O.A. temperature AI	Boiler enable/disable Low Fire DO (2)
Boiler Loop HW supply temp. AI	Boiler enable/disable High Fire DO (2)
Boiler Loop HW return temp. AI	Boiler Pump start/stop DO (2)
Boiler flame failure DI (2)	Hot Water Mixing Valve AO
Boiler status DI (2)	Combustion Air Damper DO (2)
Boiler Pump Status (2) DI	
Main Hot Water Return Temp AI	
Main Hot water Supply Temp AI	
Combustion Air Damper Proof DI (2)	
Boiler Safety Shut-Off DI	
Boiler Room Temperature AI	

S. SEQUENCE OF OPERATION – SYSTEM PUMPS

1. Whenever the system is in heating mode the pumps shall be capable of operating. Heating mode shall be enabled when outdoor air temperature drops below 65ºF (adjustable). Once enabled, one (1) pump shall operate continuously. Whenever the outdoor air temperature is above the heat enable setting, the pumps shall remain off. During unoccupied periods, if all the building zones are satisfied and the outdoor air temperature is above 48ºF the pumps may cycle on & off as needed During this mode pumps shall only cycle on if more than 3 zones (adjustable) are calling for heat. If the heating system pumps are off the boiler plant shall be disabled unless there is a call for domestic hot water (system pumps need not operate on a call for domestic hot water).

2. If a pump fails as sensed by the respective amperage switch, the standby pump shall be energized and an alarm shall be initiated through the DDC.

3. The DDC shall alternate (lead-lag) pump operation on a run-time bases to provide equal service and wear on the pumps.

4. Variable speed drives shall modulate pump Speed as required to maintain constant system differential pressure.

5. DDC Point List – Heating System Pumps
   As a minimum, the following points shall be monitored and controlled:

Input	Outputs

P-1 amp. switch AI	P-1 VFD AO
P-2 amp. switch AI	P-2 VFD AO
System Diff. Press AI	P-1 S/S DO
	P-2 S/S DO

Note: ECM pumps utilize a single 0-10Vdc signal to enable and modulate speed.

T. SEQUENCE OF OPERATION – CH-1 & HEAT EXCHANGER

1. Whenever the main heating system is active CH-1 and associated heat exchanger and pumps shall be capable of operating. CH-1 shall be disabled if the system main return water temperature rises above a setpoint of 115°. CH-1 shall be disabled if the outdoor air temperature drops below a setpoint of 15°F.
2. The CH-1 and HX shall control to maintain hot water supply temperature leaving the storage tank at the system supply temperature setpoint (see Boiler plant sequence) but in no case higher than 120°F.
3. Open a call for heat the HX system is enabled, a start command shall be sent to the either of the HX pumps.
4. If a pump fails as sensed by current sensor, the standby pump(s) shall be energized and an alarm shall be reported by the EMS. The EMS shall alternate (lead-lag) the pump operation on a run-time bases to provide equal service and wear on the pumps. In general lead/lag pumps shall rotate every 72 run hours.
5. EMS shall monitor system flow via a flow measuring station and report flow back to front-end for calculation with temperature differentials to achieve BTU energy generated by the air to water chiller/heater heat pump. In addition it shall obtain power consumption data from the CH-1 BacNet interface as available and trend in real time to the heating output.
6. DDC Point List – CH-1 & HX System

   As a minimum, the following points shall be monitored and controlled:

Input	Outputs
CH-1 Supply Temp AI	CH-1 Enable/Disable DI
CH-1 Return Temp AI	Chiller Pump #1 Start/Stop DO
HX System Supply Temp AI	Chiller Pump #2 Start/Stop DO
HX System Return Temp AI	HX Pump #1 Start/Stop DO
System Heating Supply Temp. AI	HX Pump #2 Start/Stop DO
System Heating Return Temp. AI	
CH-1 Status AI	
CH-1 Alarm AI	
CH & HX Pump Status AI (4)	

   Alarms, Status and Energy Data (via BacNet)

U. SEQUENCE OF OPERATION – RADIANT FLOOR HEAT

1. The radiant floor heat system supports the areas as shown on the plans.
2. Once the boiler plant is enabled and the outdoor air temperature is below 60°F, the respective radiant zone circulator pump (P-#) shall cycle on and the injection valve modulate to maintain the slab temperature between a minimum of 70°F and maximum of 85°F as required to maintain space heating setpoint initially set for 70°F. If room is at space heating setpoint slab temperature setpoint shall be 60°F (adj.), if room is 5°F below setpoint slab temperature setpoint shall be 85°F (adj. see schedules). The injection valve shall modulate to maintain radiant loop hot water temperature between a minimum of 60°F (adj.) and a maximum of 120°F (adj. see radiant schedule) as required to maintaian the slab and corresponding room temperature setpoint. If room is above space heating setpoint the respective injection valve shall close and the pump shall be disabled. Space temperature setpoints shall be initially set for 60°F during unoccupied periods and 68°F during occupied periods in vehicle service and 50°F in vehicle storage continuous.

   Points List

   a. As a minimum, the following points will be monitored and controlled for each radiant heating zone. See also points indicated on drawings:

Inputs	Outputs
Space temp. AI (mult.)	Hot water valve AO
Push button override DI (mult.)	Radiant heating pump P-# Start/Stop DO (mult)
Radiant supply Temp AI (mult.)	
Radiant return Temp AI (mult.)	
Slab Temp AI (mult)	
Pump status current P-# DI (mult.)	

V. SEQUENCE OF OPERATION - HOT WATER BASEBOARD

1. Space mounted temperature sensors shall enable and disable the radiation valve as required to maintain space temperature setpoint initially set for 62°F during unoccupied periods and 70°F during occupied periods. Boiler room and utility room setpoints shall be 60°F. In areas served by both radiation and VRF air heat, the radiation shall work in conjunction with the air heat with VRF system being the first stage of heat followed by the radiation with no more than an adjustable 1.0F dead-band spread.

   Points List

   a. As a minimum, the following points will be monitored and controlled for each segment of radiation. See also points indicated on drawings:

Inputs	Outputs
Space temp. AI	Hot water valve DO
Space temp. adj AI	
Push button override DI	

W. SEQUENCE OF OPERATION – GENERAL EXHAUST FANS

1. All general exhaust fans shall be controlled through the DDC and shall operate continuously during the occupied periods or as otherwise indicated herein.
2. At commencement of occupied periods motorized dampers shall open and respective exhaust fans shall start and run.
3. During unoccupied periods the exhaust damper shall close and the exhaust fans shall be disabled.
4. For fans scheduled with ECM motors or variable speed drives reflected on the control drawings with a VFD, the EMS shall send a 0 to 10 VDC signal to start and stop the fan and modulate its speed. For fans scheduled with ECM motors reflected on the control drawings with a HS or HOA, the EMS shall send a 0 to 10 VDC signal to start and stop the fan and the final running control voltage signal shall be coordinated with the balancer. For fans scheduled with ECM motors reflected on the control drawings with a HS or HOA and also scheduled to have a potentiometer dial, the EMS shall send a start and stop signal to the fan.
5. DDC Point List – General Exhaust Fans

   As a minimum the following points shall be monitored and controlled for each fan:

Inputs	Outputs
Space Temperature – AI	Start/Stop - DO
Run Indicator AI	Damper – DO
	VFD Start/Stop DO
	VFD Speed AO
	ECM VFD Fan Start/Stop & Speed AO
	ECM HS/HOA (no potentiometer) Start/Stop AO
	ECM HS/HOA (with potentiometer) Start/Stop DO

X. VEHICLE STORAGE GARAGE VENTILATION

1. The Vehicle Storage Garage is ventilated by ERV-1 (see ERV-1 sequence) as well as various exhaust fans and intakes.

2. If any of the carbon monoxide (CO) and nitrous oxide (NO) control sensors on the West half of the garage go into low level or high level alarm, the EF-1 fan shall operate and the associated exhaust damper and intake louver damper shall open. If any sensors on the East half of the garage go into low level or high level alarm, the EF-2 fan shall operate and the associated exhaust damper and intake louver damper shall open. Fans shall run until alarm condition has subsided for at least 5 minutes. If garage drops below 45°F for longer than 30 minutes a freeze alarm shall be sent to the EMS. Fans shall then operate in a freeze protection mode with alarm horn strobes operating and fans cycling on for 5 minutes every 30 minutes or until condition subsides. Review of this mode with local AHJ is required.

3. CO warning and fan activation levels shall be initially set for 20ppm and NO warning and fan activation levels shall be initially set for 5 ppm. High level audible and visual alarm conditions shall be at setpoints of initially CO=30ppm and NO=10ppm. Horns shall sound until the alarm levels subside or until manually silenced at the control panel.

4. The car wash exhaust fan shall operate and its damper open whenever the switch in the space is place on. If occupancy is not detected in the car wash bay for longer than 15 minutes the fan shall be disabled.

5. DDC Point List – Garage Ventilaiton

   As a minimum the following points shall be monitored and controlled for each fan:

Inputs	Outputs
Space Temperature – AI (mult.)	Fan Start/Stop – DO (mult.)
Run Indicator AI (mult)	Intake Damper – DO (mult.)
CO/NO Sensors (mult)	Exhaust Damper – DO (mult.)
CO/NO Low Alarm (mult)	
CO/NO High Alarm (mult)	
Occupancy Sensor (mult)	
Manual Switch (DI)	

Y. SEQUENCE OF OPERATION UNIT HEATERS UH-# & ANTI-STRATIFCATON FANS

1. Hot water coil valve shall open and heater fans shall cycle as required to maintain space temperature setpoint. Occupied and unoccupied setpoints for the Vehicle Service Garage and Shops shall be 67°F and 60°F (1°F below radiant heat setpoint). In Vehicle Storage area setpoint shall be 50°F.

2. Anti-stratification fans shall operate whenever outdoor air temperatures drop below a setpoint of 30°F or if there is a call for heat from the heaters within the area served.

2. DDC Point List – General Exhaust Fans

As a minimum the following points shall be monitored and controlled for each fan:

Inputs	Outputs
Space Temperature – AI (mult.)	UH Fan Start/Stop – DO (mult.)
Run Indicator AI (mult)	Intake Damper – DO (mult)
	AS Fan Start/Stop – AI (0-10Vdc)
	HW Valve – DI (mult.)

PART 3 - EXECUTION

3.01 SURFACE CONDITIONS

A. Examine the areas and conditions under which work of heating, ventilating and air conditioning system will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

3.02 INSTALLATION

A. Install equipment ductwork, piping and controls where shown with recognized industry standards and practices, to ensure that installation complies with requirements and serves intended purposes.

B. Coordinate with other work as necessary to interface installation of equipment with other components of systems.

C. Installation of Ductwork:

1. Installation of ductwork shall be coordinated with other work as necessary to interface installation or ductwork with other components of systems. Duct sizes shown on the drawings at connection to fans or other equipment may vary in actual installation. Contractor shall provide transition pieces as required. Ducts, casings and hangers shall be installed straight and level and shall be free of vibration and noise when fans are operating.

2. Provide safing to close all floor and wall (where fire rated) openings around ductwork - pack annular space with rockwool and 18 gauge sheet metal safing.

3. Seal the ductwork at joists with suitable water based sealers similar to DuctMate EZ Seal or approved equal. Refer to underground ductwork for required sealing.

4. When ductwork penetrates an insulated joist bay in the attic area, maintain insulation integrity. Support ductwork to prevent movement and secure insulation and fill all gaps.

5. This contractor is responsible for sleeving all duct penetrations before pouring of slab. If additional holes are required this contractor shall have pay for the coring of such holes in coordination with the general contractor and with prior consent of the Architect.

D. Installation of Piping:

1. Contractor shall examine location where the piping is to be installed and determine space conditions. Provide and erect in a workmanlike manner, according to the best practices of the trade, all piping shown on the Drawings or required to complete the installation intended by these Specifications.

2. This contractor is responsible for coring of all holes related to his/her work in coordination with the general contractor and with prior consent of the Architect.

E. Installation of Equipment:

1. Contractor shall examine location where equipment is to be installed and determine space conditions and notify Architect, in writing, of conditions detrimental to proper and timely completion of work.
2. Install equipment where shown in accordance with manufacturer's written instructions.

3.03 FIELD QUALITY CONTROL

A. Upon completion of installation of the automatic temperature control system and after motors have been energized with normal power source, test system to demonstrate compliance with requirements. When possible, field correct malfunctioning controls then retest to demonstrate compliance. Replace controls which cannot be satisfactorily corrected. Refer to Section - Test and Balancing.

3.04 SERVICE

A. After completion of the control system installation, the controls contractor shall regulate and adjust all thermostats, control valves, damper motors, etc., and place in complete operating condition, subject to the approval of the Owner. Complete instructions shall be given to the operating personnel. There shall be 40 hours of instruction given on the operation of the entire system at a training schedule determined by the Owner.

B. Start-Up and Commissioning

For all boilers, chiller/heaters and VRF units provide factory service/start-up technician to check, test and start equipment. Technician shall coordinate mapping of all control points with EMS contractor and commissioning of unit. Technician shall work with project commissioning agent to verify proper operation of unit. In coordination with the mechanical contractor and control contractor the factory technician shall provide Owner training of unit controls, maintenance, etc…

3.05 TESTING, ADJUSTING AND BALANCING (TAB)

a. General

1. Section Includes
   a. Testing, adjusting, and balancing of Air Systems.
   b. Testing, adjusting, and balancing of Hydronic Systems.
   c. Measurement of final operating conditions of HVAC Systems.
2. Related Documents
   a. Drawings and General Provisions of Contract, including General and Supplementary Conditions, apply to work of this section.
3. References
   a. ASHRAE - Standard 111 - 1988 Practices for Measurement, Testing, Adjusting, and Balancing of Building Heating, Ventilation, Air Conditioning, and Refrigeration Systems.
   b. ASHRAE - 2007 HVAC Applications Handbook: Chapter 37, Testing, Adjusting and Balancing.
   c. AABC- National Standards for Total System Balance.
   d. NEBB - Procedural Standards for Testing, Balancing and Adjusting of Environmental System.
   e. SMACNA - HVAC System Testing, Adjusting and Balancing.
   f. Sheet Metal Industry - Certification of Testing, Adjusting and Balancing Technicians.
4. Quality Assurance
   a. Agency shall be a firm specializing in the adjusting and balancing of systems specified in this Section with minimum three years documented experience, acceptable to the Designer.
   b. Perform the work under the supervision of one of the following:
      1) AABC Certified Test and Balancing Engineer.
      2) NEBB Certified Testing, Balancing, and Adjusting Supervisor.
      3) TABIC Certified Contractor.
   c. Work shall be performed only by a Balancing Sub-Sub Contractor which employs

Certified Testing, Adjusting and balancing Technicians as listed by the Sheet Metal Industry National Certification Board for TAB Technicians.

d. The work must be performed by a Certified Testing, Adjusting and Balancing
Technician who may be assisted by other TAB Technicians. The Certified Testing, Adjusting and Balancing Technician is responsible for :
1) Procedures to follow.
2) Accuracy of all testing.
3) Integrity of recorded data
4) Entering all data and any abnormal or notable conditions in report forms.
5) Initialing and dating each sheet.

e. The General Section of the Balance Report shall include the names, signatures,
and registration numbers of the Technicians who were assigned to the project.

5. Submittals
a. Submit name of the Balancing Sub-Sub Contractor for approval within 30 days after award of contract.
b. Submit for review, prior to commencement of work, a list of equipment and procedures to be used in balancing the systems.
c. Submit reports of preconstruction plan check and periodic mechanical construction review.
d. Submit draft copies of report for review prior to final acceptance of project. Provide final copies to the Designer and for inclusion in operating and maintenance manuals.

6. Procedures, General
a. All Air and Hydronic Systems shall be balanced using a procedure which results in
minimum restrictions being imposed.
1) At Completion of balancing:
a) At least one damper for an outlet/inlet shall be fully open on every branch duct.
b) At least one branch duct balancing damper shall be fully open on every trunk duct.
c) At least on trunk (zone) balancing damper shall be fully open in each Air System.
d) Supply/exhaust fan RPM shall be set so the static pressure at the terminal which is most difficult to supply/exhaust is adequate, but not excessive.
e) At least one hydronic terminal unit balancing valve in each piping branch shall be fully open.
f) At least one branch line balancing valve in each Hydronic System shall be fully open.

7. Final Reports
a. Submit reports on previously approved Test Data Forms
b. Forms shall include the following information:
1) Title Page:
a) Company name
b) Company address
c) Company telephone number
d) Name, signature, and registration number of each technician
e) Project name
f) Project location

g) Project Architect
h) Project Engineer
i) Project Contractor
j) Project altitude
k) Date of report

2) Instrument List:
a) Instrument
b) Manufacturer
c) Model
d) Serial number
e) Range
f) Calibration date

3) Air Moving Equipment
a) Designation
b) Location
c) Manufacturer
d) Model
e) Airflow, specified and actual
f) Return airflow, specified and actual
g) Outside airflow, specified and actual
h) Total static pressure (total external), specified and actual
i) Inlet pressure
j) Discharge pressure
k. Fan RPM

4) Return\ Exhaust Fan Data:
a) Designation
b) Location
c) Manufacturer
d) Model
e) Airflow, specified and actual
f) Total static pressure (total external), specified and actual
g) Inlet pressure
h) Discharge pressure
i) Fan RPM, initial and final

5) Electric Motor:
a) Manufacturer
b) HP
c) Frame
d) Phase, voltage, amperage; nameplate and actual
e) RPM
f) Service factor
g) Starter size, rating, heater elements

6) V-Belt Drive:
a) Identification
b) Driven sheave, diameter
c) Belt, size and quantity
d) Motor sheave, diameter
e) Center to center distance, maximum, minimum, and actual
f) Final components

7) Duct Traverse:
a) System zone/branch
b) Duct size
c) Area
d) Design velocity
e) Design airflow

f) Test velocity
g) Test airflow
h) Duct static pressure
i) Air temperature
j) Air correction factor

8) Air Monitoring Station Data:
a) Identification/location
b) System
c) Size
d) Area
e) Design velocity
f) Design airflow
g) Test velocity
h) Test airflow

9) Air Distribution Test sheet:
a) Air terminal number
b) Room number/location
c) Terminal type
d) Terminal Size
e) Area factor
f) Design velocity
g) Design airflow
h) Test velocity, initial and final
i) Test airflow, final
j) Percent of design airflow, initial and final

10) VAV Terminal Data:
a) Designation
b) Location
c) Manufacturer
d) Type
e) Model
f) Size
g) Design airflow
h) Actual airflow
i) Design Water Flow
j) Actual Water Flow

11) Cooling Coil Data:
a) Designation
b) Location
c) Service
d) Manufacturer
e) Size, face area, and fins/inch
f) Airflow, design and actual
g) Entering Air DB temperature, design and actual
h) Entering air WB temperature, design and actual
i) Leaving air DB temperature, design and actual
j) Leaving air DB temperature, design and actual
k) Air pressure drop, design and actual

12) Heating Coil Data:
a) Designation
b) Location
c) Service
d) Manufacturer
e) Size, face area, and fins/inch
f) Airflow, design and actual

g) Water flow, design and actual
h) Water pressure drop, design and actual
i) Entering water temperature, design and actual
j) Leaving water temperature, design and actual
k) Entering air temperature, design and actual
l) Leaving air temperature, design and actual
m) Air pressure drop, design and actual.

c. Report is to include a listing of any abnormal or notable conditions not contained in the above.

d. Provide four copies of reports in soft cover, letter size, 3-ring binder manuals, complete with index page and indexing tabs, with cover identification at front and side. Include set of reduced drawings with air outlets and equipment identified to correspond with data sheets, and indicating thermostat locations.

8. HVAC Sub-Contractor Responsibilities
   a. Prepare each system for testing and balancing
   b. Cooperate with Balancing Sub-Sub Contractor, provide access to equipment and systems. Operate systems at designated times, and under conditions required for proper testing, adjusting, and balancing.
   c. Notify Balancing Sub-Sub Contractor seven days prior to time system will be ready for testing, adjusting, and balancing.
   d. Where fans (air handling units, supply fans, return fans, exhaust fans, etc.) are provided with variable pitch sheaves, HVAC Sub-Contractor shall adjust sheaves, as required, at no additional cost to the Owner, until desired Design Points (CFM and/or Static Pressure) are reached. If adjustment of the variable pitch sheaves is beyond the range of the sheaves, HVAC Sub-Contractor shall replace sheaves, as required, at no additional cost to the Owner, until the desired Design Points (CFM and/or Static Pressure) are reached. Where fans (air handling, supply, return, exhaust, etc.) are specified with fixed ratio sheaves, HVAC Sub-Contractor shall replace sheaves with new sheaves, at no additional cost to the Owner until desired Design Points (CFM and/or Static Pressure) are reached.
9. Sequencing and Scheduling
   a. Sequencing work to commence after completion of systems and schedule completion of work before Substantial Completion of Project.
10. Drawing and Construction Review
   a. Perform a pre-construction review of the following documents:
      1) Contract drawings.
      2) Contract specifications.
      3) Addenda.
      4) Submittal data.
      5) Shop drawings.
      6) Automatic Control drawings.
   b. Prepare a report of the preconstruction review list of recommended changes to
      allow most effective balancing.
   c. Perform two construction reviews of the mechanical installation during the progress
      of the project. Purpose of the reviews to be:
      1) Identify potential problems for performing balancing.
      2) Identify modifications which will aid balancing.
      3) Schedule and coordinate balancing with other work.
   d. Prepare a report of each construction review.
11. Equipment
   a. Provide all necessary tools, scaffolding and ladders.

b. Provide all necessary instruments. Instruments shall be used and applied which are best suited to the system function being tested. Instruments shall be in first class state of repair and have been calibrated within a period of six months prior to starting the job. Calibration history of each instrument shall be available for examination. Instruments shall be re-calibrated upon completion of the job if required by the Designer to prove reliability.

12. Examination
    a. Before commencing work, verify that systems are complete and operable. Ensure the following:
        1) Equipment is operable an in safe and normal condition.
        2) Temperature control systems are installed complete and operable.
        3) Proper thermal overload protection is in place for electrical equipment.
        4) Final filters are clean and in place. If required, install temporary media in addition to final filters.
        5) Duct systems are clean of debris.
        6) Correct fan rotation.
        7) Fire and volume dampers are in place and open.
        8) Coil fins have been cleaned and combed.
        9) Access doors are closed and duct end caps are in place.
        10) Air outlets are installed and connected.
        11) Duct system leakage has been minimized.
        12) Proper strainer baskets are clean and in place.
        13) Correct pump rotation.
        14) Hydronic systems have been flushed, filled, and vented.
        15) Service and balance valves are open.
    b. Report to the Designer any defects or deficiencies noted during performance of services.
    c. Promptly report abnormal conditions in mechanical systems or conditions which prevent system balance.
    d. If, for design reasons, system cannot be properly balanced, report as observed.
    e. Beginning of work means acceptance of existing conditions.
13. Preparation
    a. Provide instruments required for testing adjusting and balancing operations. Make instruments available to the Designer to facilitate spot checks during testing.
14. Installation Tolerances
    a. Adjust Air Handling Systems to the following tolerances:
        1) Supply systems shall be balanced so that:
            a) The total quantity to each space is within -5% to +10% of design values.
            b) If two outlets in space, each outlet is within -10% to +10% of design value.
            c) If three or more outlets in space, each outlet is within -15% to +15% of design value.
        2) Exhaust and return systems shall be balanced so the total quantity from each space is -10% to +10% of design values.
    b. Adjust Hydronic Systems to the following tolerances:
        1) Heating System:
        a)Supply water temperature above 160°F: -10% to +10% of design value.
15. Adjusting

a. Recorded data shall represent actually measured or observed condition.
b. Permanently marked settings of valves, dampers, and other adjustment devices, allowing settings to be restored. Set and lock memory stops.
c. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.
d. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

16. Air System Procedure
    a. Measure and balance air quantities at air inlets an outlets.
    b. Adjust Air Handling and Distribution Systems to provide design supply, return and exhaust air quantities at site altitude.
    c. Make air quantity measurements in ducts by pitot tube traverse of entire cross sectional area duct.
    d. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.
    e. Effect volume control at outlets by use of dampers installed in the ductwork. Do not use volume dampers that are integral with the outlets.
    f. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for 50 percent loading of filters.
    g. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.

    h. Measure temperature conditions across outside air, return air, and exhaust air dampers to check leakage.
    i. Where modulating dampers are provided, take measurements and balance at extreme conditions. Set variable volume terminals at maximum airflow rate, full cooling with design diversity; read volumes at minimum airflow rate and full heating.
    j. Measure building static pressure and adjustable supply, return and exhaust air systems to provide required relationship between each to maintain approximately 0.05 inches positive static pressure near the building entries.
17. Water System Procedure
    a. Adjust water systems to provide design quantities.
    b. Use calibrated flow meters and pressure gages to determine flow rates for system balance. Where flow metering devices are not installed, base flow balance on temperature difference across various heat transfer elements in the system.
    c. Adjust systems to provide specified pressure drops and flows through heat transfer elements prior to thermal testing. Perform balancing by measurement of temperature differential in conjunction with air balancing.
    d. Effect system balance with automatic control valves fully open to heat transfer elements.
    e. Effect adjustment of water distribution systems by means of balancing cocks, valves, and fittings. Do not use service or shut-off valves for balancing unless indexed for balance point.
18. Field Verification
    a. The Designer may request verification of the data contained in the Balancing Report. If so, the TAB Technician who originally initialed the data

sheets shall read outlets selected at random by the Designer who will compare the values with those in the report.
b. It is understood that the verification process shall take place within one week after delivery of the report. The operating mode of the system shall be the same for verification as it was during the balancing procedure.
c. The number of readings to be verified shall not exceed 10% of the total contained in the report.
d. If the field verification is not satisfactory, the firm doing the TAB work shall completely rebalance the system and a new report shall be prepared. The Designer may notify the Sheet Metal Industry Certification Board for TAB Technicians so that appropriate action can be taken.

B. It shall be division 23.00.00 responsibility to provide all personnel as required to fully coordinate with the commissioning agent as applicable. The hours of training and instruction outlined in division 23.00.00 and the Testing and Balancing requirements shall be in addition to those tests and requirements outlined in the commissioning section as applicable.

C. Certified Reports

1. For the reports required to be submitted within this section, provide certification by an independent balancing and testing contractor who is versed in the field of air balancing and who is not affiliated with any firm involved in the design or construction phases of this work.

2. Identify in the reports each item not complying with the Contract requirements, or obvious misoperation or design deficiencies of equipment or controls.

D. Additional Commissioning Coordination & Requirements

1. The Testing, Adjusting, & Balancing (TAB) Balancing Contractor shall submit their TAB procedures as part of the SUBMITTAL criteria in Division 1 of this specification. Integral with this submittal shall be the TAB strategy/plan for water system, which shall include the following
   a. Furnish one-line, schematic system drawings for the Commissioning Agent review of the Hot Water Piping System.
2. Each hydronic system drawing will be 1-line schematic representation of the system to be they are installed, indicating all coils, balancing valves, strainers, automatic control valves, pressure regulating valves, meters, etc.
3. Each hydronic system flow diagram shall indicate all pressure drops (design conditions and actual conditions) of each component, as well as associated flows and temperatures (design and actual).
4. Furnish one-line, schematic system drawings for the Commissioning Agent review of the Duct System for the follows:
   a. Central HVAC system(s)

b. General exhaust system(s)

5. Each air system drawing will be 1-line schematic representation of the system to be they are installed, indicating all louvers, dampers, filters, coils, fans, dampers, balancing valves, volume terminal devices, etc.

6. Each air system flow diagram shall indicate all pressure drops (design conditions and actual conditions) of each component, as well as associated flows, velocity, and temperatures (design and actual)

3.06 LABELING

A. Provide pipe markers of either pressure sensitive tape or laminated plastic, color coded and indicating the type and direction of flow of the piping service. Duct labels shall be stenciled and painted on the ductwork. All heating supply and return water, cold (domestic) water feeding HVAC systems, condensate drain piping and refrigerant piping throughout the building shall be labeled. All supply, return and exhaust ductwork mains shall be labeled with flow direction, service and associated air moving unit. Ducts and piping excluded from the labeling requirement are any of the following: 1) Ducts exposed within finished spaces. Labels shall be at the inlet and outlet to each piece of equipment, at the entrance and exit of each room and at intervals along the duct and pipe of a minimum of every 20 feet.

B. All equipment, starters and VFD’s shall be labeled with engraved laminated nametags.

C. 1-1/2” Brass valve tags with recessed stamped black lettering indicating service and valve number shall be provided at every shut-off, bypass and control valve in the building. Shut-off valves at individual unit heaters and baseboard heaters located within 5 feet of the serviced terminal need not be tagged. A typed valve chart shall be made and inserted in each copy of the operation and maintenance. In addition the valve chart shall be mounted in a glass frame affixed to a wall in the boiler room. Chart shall show valve number, valve type and valve service. Directions for system seasonal drain down or isolation of components shall be included on this chart.

3.07 PAINTING

A. Equipment installed under this Section shall have shop coat of factory applied non-lead paint, unless otherwise specified. Touch-up any scratches with matching paint. Hangers and supports shall have one coat of non-lead primer.

3.08 SPARE STOCK

A. Air Filters:

It is the intent of this specification that all equipment requiring or specified with air filters be furnished with four (4) spare sets of filters for each piece of equipment in addition to those supplied with the unit. Presuming the unit has not been operated during construction (operation during construction only allowed with written approval from Architect) the set of filters initially installed in the unit shall be utilized during testing and balancing and building flush out. After flush out, a new set of air filters shall be installed leaving the Owner with three (3) full spare sets. All filters shall have minimum efficiency of MERV 8. All equipment filter sections must be fitted with differential pressure gauges. Gauges shall be connected to EMS where specified elsewhere in this specification.

B. Belts:

It is the intent of this specification that all equipment requiring or specified with belt drives be furnished with two (2) spare sets of belts for each piece of equipment in addition to those supplied with the unit.

C. Consumables and Other Spare Stock:

Any items considered consumable or required for routine maintenance and service replacement within the first 18 months of an equipment's operation shall be supplied of adequate quantity to operate the equipment for a period of 24 months. This shall include but not be limited to boiler ignitors and other items required for routine maintenance/replacement in equipment with the first 18 months of operation.

END OF SECTION

SECTION 23 08 00

COMMISSIONING OF HVAC
(Filed Sub Bid Required as Part of Section 23 00 00)

PART 1 - GENERAL

1.01 SUMMARY

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 1 – GENERAL REQUIREMENTS, which are hereby made a part of this Section of the Specifications.

B. Section includes commissioning process requirements for HVAC&R systems, assemblies, and equipment.

A. **Work in this Section is included as part of the work in Section 23 00 00**.

1.02 RELATED SECTIONS

A. Section 01 77 00, PROJECT CLOSEOUT PROCEDURES.

B. Section 01 91 13, GENERAL COMMISSIONING.

C. Section 23 00 01, HVAC.

1.03 DEFINITIONS

A. Commissioning Plan: A document that outlines the organization, schedule, allocation of resources, and documentation requirements of the commissioning process.

B. CA: Commissioning Agent/Commissioning Authority. An entity who leads, plans, schedules and coordinates the Cx team to implement the Cx process.

C. HVAC&R: Heating, Ventilating, Air Conditioning, and Refrigeration.

D. Systems, Subsystems, Equipment, and Components: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, equipment, and components.

1.04 SUBMITTALS

A. Certificates of readiness.

B. Certificates of completion of installation, prestart, and startup activities.

1.05 ALLOWANCES

A. Labor, instrumentation, tools, and equipment costs for technicians for the performance of commissioning testing.

1.06 CONTRACTOR'S RESPONSIBILITIES

A. Perform commissioning tests at the direction of the CA.

B. Attend construction phase controls coordination meeting.

C. Attend testing, adjusting, and balancing review and coordination meeting.

D. Participate in Plumbing systems, assemblies, equipment, and component maintenance orientation and inspection as directed by the CA.

E. Provide information requested by the CA for final commissioning documentation.

F. Provide measuring instruments and logging devices to record test data, and provide data acquisition equipment to record data for the complete range of testing for the required test period.

1.07 COMMISSIONING AGENT'S RESPONSIBILITIES

A. Provide Project-specific construction checklists and commissioning process test procedures for actual HVAC&R systems, assemblies, equipment, and components to be furnished and installed as part of the construction contract.

B. Direct commissioning testing.

C. Verify testing, adjusting, and balancing of Work are complete.

D. Provide test data, inspection reports, and certificates in Systems Manual.

1.08 COMMISSIONING DOCUMENTATION

A. Provide the following information to the CxA for inclusion in the commissioning plan:
   1. Plan for delivery and review of submittals, systems manuals, and other documents and reports.

2. Identification of installed systems, assemblies, equipment, and components including design changes that occurred during the construction phase.
3. Process and schedule for completing construction checklists and manufacturer's prestart and startup checklists for HVAC&R systems, assemblies, equipment, and components to be verified and tested.
4. Certificate of completion certifying that installation, prestart checks, and startup procedures have been completed.
5. Certificate of readiness certifying that HVAC&R systems, subsystems, equipment, and associated controls are ready for testing.
6. Test and inspection reports and certificates.
7. Corrective action documents.
8. Verification of testing, adjusting, and balancing reports.

PART 2 -PRODUCTS (NOT USED)

PART 3 -EXECUTION

3.01 TESTING PREPARATION

A. Certify that HVAC&R systems, subsystems, and equipment have been installed, calibrated, and started and are operating according to the Contract Documents.

B. Certify that HVAC&R instrumentation and control systems have been completed and calibrated, that they are operating according to the Contract Documents, and that pretest set points have been recorded.

C. Certify that testing, adjusting, and balancing procedures have been completed and that testing, adjusting, and balancing reports have been submitted, discrepancies corrected, and corrective work approved.

D. Set systems, subsystems, and equipment into operating mode to be tested (e.g., normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).

E. Inspect and verify the position of each device and interlock identified on checklists.

F. Check safety cutouts, alarms, and interlocks with smoke control and life-safety systems during each mode of operation.

G. Testing Instrumentation: Install measuring instruments and logging devices to record test data as directed by the CxA.

3.02 TESTING AND BALANCING VERIFICATION

A. Prior to performance of testing and balancing Work, provide copies of reports, sample forms, checklists, and certificates to the CxA.

B. Notify the CxA at least 10 days in advance of testing and balancing Work, and provide access for the CxA to witness testing and balancing Work.

C. Provide technicians, instrumentation, and tools to verify testing and balancing of HVAC&R systems at the direction of the CxA.
   1. The CxA will notify testing and balancing Contractor 10 days in advance of the date of field verification. Notice will not include data points to be verified.
   2. The testing and balancing Contractor shall use the same instruments (by model and serial number) that were used when original data were collected.
   3. Failure of an item includes, other than sound, a deviation of more than 10 percent. Failure of more than 10 percent of selected items shall result in rejection of final testing, adjusting, and balancing report. For sound pressure readings, a deviation of 3 dB shall result in rejection of final testing. Variations in background noise must be considered.
   4. Remedy the deficiency and notify the CxA so verification of failed portions can be performed.

3.03 GENERAL TESTING REQUIREMENTS

A. Provide technicians, instrumentation, and tools to perform commissioning test at the direction of the CxA.

B. Scope of HVAC&R testing shall include entire HVAC&R installation, from central equipment for heat generation and refrigeration through distribution systems to each conditioned space. Testing shall include measuring capacities and effectiveness of operational and control functions.

C. Test all operating modes, interlocks, control responses, and responses to abnormal or emergency conditions, and verify proper response of building automation system controllers and sensors.

D. The CxA along with the HVAC&R Contractor, testing and balancing Contractor , and HVAC&R Instrumentation and Control Contractor shall prepare detailed testing plans, procedures, and checklists for HVAC&R systems, subsystems, and equipment.

E. Tests will be performed using design conditions whenever possible.

F. Simulated conditions may need to be imposed using an artificial load when it is not practical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as

directed by the CxA and document simulated conditions and methods of simulation. After tests, return settings to normal operating conditions.

G. The CxA may direct that set points be altered when simulating conditions is not practical.

H. The CxA may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are not practical.

I. If tests cannot be completed because of a deficiency outside the scope of the HVAC&R system, document the deficiency and report it to the Owner. After deficiencies are resolved, reschedule tests.

J. If the testing plan indicates specific seasonal testing, complete appropriate initial performance tests and documentation and schedule seasonal tests.

3.04 CONTRACTOR'S ATC MONITORING REQUIREMENTS

A. Provide support as needed to the CA in utilizing ATC and metering equipment to measure energy and water usage. Monitor, record, and trend log measurements.

END OF SECTION

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SECTION 26 00 00
Electrical Work

(Filed Sub-Bid)

1.1 DESCRIPTION

A All of the Contract Documents, including General and Supplementary conditions and Division 0 – Bidding Documents, Contract Forms and Conditions of the Contract and Division 1 – General Requirements, apply to the work in this Section.

B Carefully examine all the Contract Documents for requirements which affect the work of this Section. The exact scope of this Section cannot be determined without a thorough review of all specifications sections and other Contract Documents.

C Where referred to, Standard Specifications, Recommendations of Technical Societies, and/or Manufacturer's Associations, plus Codes of Federal, State, and Local Agencies shall include all amendments current as of date of issue of these specifications.

1.2 REQUIREMENTS FOR SUBMITTING FILED SUB-BID

A. Sub-bids shall be submitted for the Work of this Section in accordance with the provisions of M.G.L. c.149 §§44A-J The time and place for submission of sub-bids are set forth in the **Advertisement.** The procedures and requirements for submitting sub-bids are set forth in the **Instructions to Bidders.**

B. Sub-bidders must be DCAMM Certified in the listed trade and shall include a Current DCAMM sub-bidder Certificate of Eligibility and a signed DCAMM Sub-bidder’s Update Statement with the bid

C. Specification requirements for the Filed Sub-bid "Electrical Work" include all of the following listed Specification Sections in their entirety.

SECTION 01 91 13 - GENERAL COMMISSIONING
SECTION 26 00 01 - ELECTRICAL
SECTION 26 08 00 - COMMISSIONING OF ELECTRICAL

D. The Work of this Section is shown on Drawings

TS-001, R-101, R-102, A-001, A-301, A-302, E-001, E-101, E-102, E-201, E-202, E-300, E-301, E-302, E-303, FA-101, FA-102, ES-101, ES-102

E. SUB-SUBS

1. Sub-sub bids are required for this Section. Sub-Bidders shall include the appropriate information for the list of sub sub-bid Class of Work noted below in this paragraph. NOT APPLICABLE

2. If the Filed Sub-Bidder customarily performs the above Work with its own workforce, the Sub-Bidder should list its own name and trade and leave the dollar amount blank.

3. If the Filed Sub-Bidder does not customarily perform the Classes of Work with its own workforce, the Sub-Bidder should list the name of the contractor performing the work, the trade and insert a dollar amount.

END OF SECTION

SECTION 26.00.01
ELECTRICAL
(Filed Sub-Bid)

PART 1 – GENERAL

1.01 DESCRIPTION

A. This section specifies requirements for electrical construction. The Electrical Contractor shall provide install flashing for all Work related to this Section.

B. All of the Contract Documents, including General and Supplementary conditions and Division 0 – Bidding Documents, Contract Forms and Conditions of the Contract and Division 1 – General Requirements, apply to the work in this Section.

C. Carefully examine all the Contract Documents for requirements which affect the work of this Section. The exact scope of this Section cannot be determined without a thorough review of all specifications sections and other Contract Documents.

D. Where referred to, Standard Specifications, Recommendations of Technical Societies, and/or Manufacturer's Associations, plus Codes of Federal, State, and Local Agencies shall include all amendments current as of date of issue of these specifications.

1.02 GENERAL

A. The General Conditions and Supplementary General Conditions of these specifications are hereby made a part of this Section.

B. Refer to drawings for further definition of location, extent, and details of work described herein.

C. Cooperate and coordinate with other trades in executing work as described in this Section.

D. Where referred to, Standard Specifications, Recommendations of Technical Societies, and/or Manufacturer's Associations, plus Codes of Federal, State, and Local Agencies shall include all amendments current as of date of issue of these specifications.

1.03 SCOPE:

A. Work described herein shall be interpreted as work to be done by the Electrical Subcontractor. Work to be performed by other trades will be referenced to a particular contractor or subcontractor.

B. Provide all labor, materials, tools, and equipment, including scaffolding, to complete the installation of the electrical system. Install, equip, adjust, and put into operation the respective portions of the installation specified, and so interconnect various items or sections of work in order to form a complete and operating whole. The work shall consist of, but shall not necessarily be limited to, the following:

1. Primary conduits, risers etc.
2. Coordination with local utilities. Work to include obtaining work order from the local utility.
3. Secondary distribution equipment, including secondary switchboards and metering, surge suppressor, motor controls, distribution panels, and panelboards including feeders and sub-feeders.
4. Voice Evacuation Fire alarm system (low voltage)
5. Emergency power system, including diesel fueled emergency generator, a full tank of diesel fuel, emergency lighting, and exit signs.
6. Lighting systems exterior and interior, including fixtures, lamps, time clocks, and controls.
7. Photovoltaic system, including panels, inverters, all associated wiring, metering/monitoring, and commissioning.
8. All raceway systems, including boxes, couplings, and fittings.
9. Fully functioning card access system and commissioning
10. Fully functioning closed circuit television system
11. All branch circuit wiring systems, including wiring devices, plates.
12. Card access conduit system only with pull strings. Plus, coordination with towns card access vendor.
13. Excavation and backfill
14. Connections for all building equipment, including heating, ventilation, and air conditioning, plumbing, fire protection, elevators, and the like.
15. Telecommunication wiring, devices, and testing.
16. Drilling, coring, and cutting of holes and openings where the largest dimension thereof does not exceed 12 inches, for electrical conduits, wiring, and equipment.
17. Scaffolding, rigging, and staging required for all electrical work.
18. Fire stopping shall be performed by the electrical contractor.
19. Provide seismic restraints for all electrical systems and conform to Massachusetts State Building Code.
20. Coordination with local utility, obtaining work orders, plus filling out all interconnection agreement paper work.
21. Phasing

22. **Arc Flash /coordination Study. No shop drawings will be approved until report is submitted to engineer of record.**
23. All testing of equipment installed.
24. Any other item of work hereinafter specified or indicated on electrical drawings.
25. Energy rebate paper work

1.04 DEFINITIONS:

A. Most terms used within the documents are industry standard. Certain words or phrases shall be understood to have specific meanings as follows:

1. Provide: Furnish and install completely connected up and in operable condition.
2. Furnish: Purchase and deliver to a specific location within the building or site.
3. Install: With respect to equipment furnished by others, install means to receive, unpack, move into position, mount, and connect including removal of packaging materials.
4. Conduit: Raceways of the metallic type, which are not flexible. Specific types as specified.
5. Connect: To wire up, including all branch circuitry, control and disconnection devices so item is complete and ready for operation.
6. Subject to Mechanical Damage: Equipment and raceways installed exposed and less than eight feet above finished floor in mechanical rooms or other areas where heavy equipment may be in use or moved.

1.05 ITEMS TO BE FURNISHED ONLY:

A. Furnish the following items for installation under designated sections.

1. Muffler and flexible exhaust connection SECTION 15600, HVAC

1.06 RELATED WORK:

A. The following related work is to be performed under designated sections.

1. Cast in place concretes: SECTION 03 30 00
2. Finish Painting: SECTION 09 90 00, PAINTING.
3. General Commissioning requirements 01 64 00
4. Automatic Temperature Control: SECTION 23 00 01, HEATING, VENTILATING, AND AIR CONDITIONING.

5. Payment for energy for temporary light and power shall be made by General Contractor.
6. Patching: To be done by trade responsible for surface requiring patching.

1.07 CONTRACT COST BREAKDOWN:

A. The following related work is to be performed under designated sections.

1.08 INSPECTION OF SITE:

A. Electrical bidders shall inspect site. Failure to inspect existing conditions or to fully understand work which is required shall not excuse Electrical Subcontractor from his obligations to supply and install work in accordance with specifications and the drawings and under all site conditions, as they exist.

1.09 CONTRACTOR'S REPRESENTATIVE:

A. Retain a competent representative on the project.

1.10 COOPERATION:

A. Work shall be carried on under usual construction conditions, in conjunction with other contractors work. Cooperate with other contractors, coordinate work, and proceed in a manner as not to delay progress.

B. Before proceeding, examine all construction drawings and consult other contractors to coordinate installation and avoid interference.

C. In case of dispute, the Architect will render a decision in accordance with General and Supplementary General Conditions.

1.11 CODES, ORDINANCES, AND PERMITS:

A. Codes and Ordinances:

1. All material and work provided shall be in accordance with the following codes and standards as most recently amended.
National Electrical Code, 2017 Edition
Massachusetts Electric Code Amendments, 2017 Edition
Commonwealth of Massachusetts State Building Code, 9th Edition
International Building Code (IBC), 2015 Edition
State Department of Public Safety

NFPA 101 "Life Safety Code"
Standards of the Underwriters Laboratories (UL)
Occupational Safety and Health Act (OSHA)
Americans with Disabilities Act (ADA)
Energy Conservation Code
International Energy Conservation Code (IECC), 2015Edition
Town of Montague
ANSI/TIA/EIA-568-B.1 and addenda “Commercial Building Telecommunications Cabling Standard - Part 1: General Requirements”
ANSI/TIA/EIA-568-B.2 and addenda “Commercial Building Telecommunications Cabling Standard - Part 2: Balanced Twisted-Pair”
ANSI/TIA/EIA-568-B.3 and addenda “Commercial Building Telecommunications Cabling Standard - Part 3: Optical Fiber Cabling and Components Standard”
ANSI/TIA/EIA-569-B and addenda “Commercial Building Standard for Telecommunications Pathways and Spaces”
ANSI/TIA/EIA-606-A and addenda “Administration Standard for the Telecommunications Infrastructure of Commercial Buildings”
ANSI-J-STD-607-A and addenda “Commercial Building Grounding and Bonding Requirements for Telecommunications”
IEC/TR3 61000-5-2 - Ed. 1.0 and amendments “Electromagnetic compatibility (EMC) - Part 5: Installation and mitigation guidelines - Section 2: Earthing and Cabling”
ISO/IEC 11801:2002 Ed2.0 and amendments “Information technology - Generic Cabling for Customer Premises”
EIA 310-D “Cabinets, Racks, Panels, and Associated Equipment.”
EIA/TIA TSB 75 “Additional Horizontal Cabling Practices for Open Offices.”

2. Where contract documents indicate more stringent requirements than codes, the contract documents shall take precedence.

B. Permits: Be responsible for filing documents, payment of fees, and securing of inspection and approvals. See allowances for back charges for utility company work in conjunction with the permanent electric service.

1.12 ELECTRICAL ROOMS OR SPACES:

A. Be responsible for ensuring that the dedicated space and clearances required in the NEC, Section 110.26 is maintained for all electrical equipment.

B. Call other contractors' attention to the requirements contained in the above mentioned code sections, prior to the installation of equipment by other contractors, in order to ensure no violations.

1.13 SUBMITTALS:

A. Refer to Supplementary General Conditions for information relative to submission of shop drawings. No equipment for which review is required shall be installed prior to review, except at Contractor's own risk. Shop Drawings will be required for all electrical equipment.

1.14 GUARANTEE:

A. Keep work in repair without expense to Owner as far as concerns defects in workmanship or materials for a period of not less than one year from date of substantial completion.

1.15 ELECTRICAL CHARACTERISTICS:

A. In general, and unless specifically indicated otherwise, all building service, heating, ventilating, air conditioning, and plumbing equipment shall be of the following characteristics.

1. Motors up to and including 1/3 HP shall be suitable for 120 volts, one phase operation.
2. Motors larger than 1/3 HP shall be suitable for 208 volts, three phase operation.
3. Electric heating equipment 4 KW and less shall be suitable for 208 volt, single-phase operation. Over 4KW shall be 208 volt three phase.

B. Power Factor: All equipment provided rated greater than 1,000 watts and lighting equipment greater than 15 watts with an inductive reactance load component shall have a power factor of not less than 90% under rated load conditions.

1.16 TEMPORARY LIGHT AND POWER:

A. Refer to and comply with SECTION 01 55 00, TEMPORARY FACILITIES

1.17 TEMPORARY SUPPORT FACILITIES:

A. Refer to and comply with SECTION 01 50 00, TEMPORARY FACILITIES

1.18 RECORD DRAWINGS:

A. Refer and comply with SECTION 01 77 00, PROJECT CLOSEOUT

1.19 OPERATING INSTRUCTIONS AND MAINTENANCE MANUALS:

A. Refer to and comply with SECTION 01 77 00, PROJECT CLOSEOUT

1.20 INSPECTIONS AND TESTS:

A. Inspection: If inspection of materials installed shows defects, such defective work, materials, and/or equipment shall be replaced and inspection and tests repeated.

B. Tests: Make reasonable tests and prove integrity of work and leave electrical installation in correct adjustment and ready to operate. All panels and switchboards shall have phases balanced as near as practical. A consistent phase orientation shall be adhered to at all terminations.

1.21 RETURN AIR PLENUM:

A. Area above hung ceiling is a return air plenum. All wiring systems, therefore, including telephone and/ or data, must either be run in conduit or shall be "UL listed" plenum cable.

PART 2 - PRODUCTS

2.01 GENERAL:

A. Product specifications are written in such a manner so as to specify what materials may be used in a particular location or application and therefore do not indicate what is not acceptable or suitable for a particular location or application. As an example: non-metallic sheathed cable is not specified; therefore, it is not acceptable.

B. For purpose of establishing a standard of quality and not for purpose of limiting competition, the basis of this Specification is upon specified models and types of equipment and materials, as manufactured by specified manufacturers.

C. In all cases, standard cataloged materials and systems have been selected. Materials such as lighting fixtures specially manufactured for this particular project and not part of a manufacturers' standard product line will not be acceptable. In the case of systems, the system components shall be from a single source regularly engaged in supplying such systems. A proposed system made up of a collection of various manufacturers' products will be unacceptable.

D. Where Specifications list manufacturers' names and/or "as approved" or "Equal approved by Architect", other manufacturers' equipment will be considered if equipment meets Specification requirements and has all features of the specified items as are considered essential by Architect.

E. All material shall be new and shall be UL listed.

2.02 RACEWAYS AND FITTINGS:

A. Raceways - General:

1. No raceway shall be used smaller than 1/2" diameter and shall have no more than four (4) 90° bends in any one run, and where necessary, pull boxes shall be provided. Only rigid metal conduit or intermediate metal conduit is allowed for slab work. Cable systems, if allowed to be used by other sections of this specification, shall not be used exposed or in slabs, whether listed by "UL" for such use or not.
2. Rigid metal conduit conforming to, and installed in accordance with, Article 344 shall be heavy wall zinc coated steel conforming to American Standard Specification C80 1 and may be used for service work, exterior work, slab work, and below grade level slab, wet locations, where raceway may be subject to mechanical damage.

3. Intermediate Metal Conduit (IMC) conforming to, and installed in accordance with, Article 342, may be used for all applications where rigid metal conduit is allowed by these specifications.
4. Electrical Metallic Tubing (EMT), conforming to, and installed in accordance with, Article 358 shall be zinc coated steel, conforming to industry standards, may be used in masonry block walls, stud partitions, above furred ceilings, where exposed but not subject to mechanical damage, and shall be used for fire alarm work.
5. Flexible metal conduit shall be used for final connections to recessed lighting fixtures from above ceiling junction boxes and for final flexible connections to motors and other rotating or vibrating equipment. Liquid tight flexible metal conduit shall be used for the above connections which are located in moist locations. All flexible connections shall include an insulated grounding conductor.
6. Rigid non-metallic conduits shall be polyvinyl chloride (PVC) schedule 80, 90°C (thick wall) conforming to and installed in accordance with ARTICLE 352, may be used below slab within the foundation wall and underground outside the foundation wall. No concrete encasement is required below slab within the foundation wall or site lighting branch circuit work.
7. Acceptable manufacturers:
   Robroy Industries
   Republic Conduit
   Youngstown Tube Company
   Carlon
   Allied Tube and Conduit
8. Fittings:
   a. Provide insulated bushings on all raceways 1 inch diameter or larger.
   b. Manufacturer's standard fittings shall be used for raceway supports.
   c. Expansion Fittings: Expansion fittings shall be used where structural and concrete expansion joints occur and shall include a ground strap.
   d. Couplings for rigid metal and intermediate metal conduit shall be threaded type.
   e. Threadless fittings for EMT shall be watertight compression type (wet locations) or set screw type (dry locations). All fittings shall be concrete tight. No diecast fittings allowed except for raceways larger than 1-inch diameter.
   f. Cable supports in vertical raceways shall be of the split wedge type. Armored cable supports for vertical runs to be of wire mesh basket design.
   g. Wall entrance seals shall be equal to O.Z. Gedney type "WSK".

h. Couplings, elbows and other fittings used with rigid nonmetallic conduit shall be of the solvent cemented type to secure a waterproof installation.

i. Acceptable manufacturers:
   O.Z.
   Crouse Hinds
   Appleton
   EFCOR
   Steel City

B. Outlets, Pull and Junction Boxes:

1. Outlets:
   a. Each outlet in wiring or raceway systems shall be provided with an outlet box to suit conditions encountered. Boxes installed in normally wet locations or surface mounted shall be of the cast metal type having hubs. Concealed boxes shall be cadmium plated or zinc coated sheet metal type. Old work boxes with Madison clamps not allowed in new construction. Thru the wall boxes are not permitted.
   b. Each box shall have sufficient volume to accommodate number of conductors in accordance with requirements of Code. Boxes shall not be less than 1 1/2" deep unless shallower boxes are required by structural conditions and are specifically approved by Architect. Ceiling and bracket outlet boxes shall not be less than 4" octagonal except that smaller boxes may be used where required by particular fixture to be installed. Flush or recessed fixtures shall be provided with separate junction boxes when required by fixture terminal temperature requirements. Switch and receptacle boxes shall be 4" square or of comparable volume.
   c. Far side box supports shall be Caddy J 1A.
   d. Acceptable manufacturers:
      Appleton
      Crouse Hinds
      Steel City
      RACO
2. Pull and Junction Boxes:
   a. Where indicated on plans, and where necessary to terminate, tap off, or redirect multiple raceway runs or to facilitate conductor installation, furnish, and install appropriately designed boxes. Boxes shall be fabricated from code gauge steel assembled with corrosion resistant machine screws. Box size shall be as required by Code.
   b. Boxes in moist or wet areas shall be galvanized type. Boxes larger than 4 11/16 inches square shall have hinged covers. Boxes larger than 12 inches in one dimension will be allowed to have screw

fastened covers, if a hinged cover would not be capable of being opened a full 90 degrees due to installation location.

c. Acceptable Manufacturers:
   Hoffman
   Keystone
   Lee Products Co.

2.03 CONDUCTORS:

A. All conductors shall be a minimum size of #12 AWG except for control wiring and fire alarm wiring where #14 AWG may be used. For all exit sign circuits, normal/emergency and/or emergency only circuits, exterior lighting circuits, and also where distance from panelboard to first outlet exceeds 80', #10 AWG shall be minimum size wire allowed. All feeder and branch circuit conductor shall be color coded as follows:

1.	208Y/120V	Phase A	Black
2.	208Y/120V	Phase B	Red
3.	208Y/120V	Phase C	Blue
4.	Grounded Conductor	120/208	White
5.	Equipment Ground	120/208	Green

B. All conductors not installed in accordance with color scheme shall be replaced. All conductors larger than #6 AWG must be identified with colored tape.

C. Connections throughout the entire job shall be made with solderless type devices.

1. For #10 AWG and smaller: spring type.
2. For #8 AWG and larger: circumferential compression type.
3. Acceptable manufacturers:
   3M "Scotchlock"
   IDEAL "Wingnut"
   BURNDY

4. Any splices made up in ground mounted pull boxes shall be resin cast waterproof type or waterproof pressure type, as manufactured by King Technology, St. Louis, MO.

D. Conductors shall be copper, soft drawn, and annealed of 98% conductivity. Conductors larger than #10 AWG shall be stranded; #10 AWG and smaller shall be solid. Conductors shall be insulated for 600 volts and be of following types:

1. All conductors shall have heat/moisture resistant thermoplastic insulation type THHN/THWN (75°C) except as follows:
   a. In sizes #1 AWG and larger: Crosslinked polyethylene insulation type XHHW (75°C, 90°C) may be used.

b. Fire alarm system conductors shall be #14 AWG, type THHN, solid. Color coding of fire alarm conductors shall be in accordance with fire codes.
c. Fixture whips #16AWG type "SF".

E. Stranded conductors for all wiring systems except fire alarm will be allowed if installed and terminated as specified under Execution Section.

F. Type MC cable may be used for concealed branch circuits where allowed by code if installed and terminated as specified under Execution Section. Armor to be galvanized steel or aluminum, and shall be UL listed for 2 hour fire wall penetration.

G. Acceptable manufacturers:

South Wire
American Flexible Conduit Company
American Wire & Cable
Superior Essex
Okonite

2.04 ACCESS PANELS:

A. Provide access panels for access to concealed junction boxes and to other concealed parts of system that require accessibility for operation and maintenance. In general, electrical work shall be laid out so access panels are not required.

B. Access panels shall be located in a workmanlike manner in closets, storage rooms, and/or other non public areas, positioned so that junction can be easily reached and size shall be sufficient for purpose (minimum size 12" x 12"). When access panels are required in corridors, lobbies, or other habitable areas, they shall be located as directed.

C. Access panels shall be prime painted and equipped with screwdriver operated cam locks.

D. Acceptable manufacturers:

Inland Steel Products Company Milcor
Miami Carey
Walsh Hannon Gladwin, Inc. Way Locator

E. Specific types:

1. Acoustical Tile Ceiling "Milcor Type AT"

2.	Plastered Surfaces	"Milcor Type K"
3.	Masonry Construction	"Milcor Type M"
4.	Drywall Construction	"Milcor Type DW"

F. Furnish access panel shop drawings.

2.05 SLEEVES, INSERTS, AND OPENINGS:

A. Sleeves: Provide sleeves of proper sizes for all openings required in concrete floors and walls. Sleeves passing through floors shall be set with top of sleeve 1" above finished floor. Core drilling will also be acceptable if in accordance with any structural standards. Any un-sleeved openings shall be waterproofed.

B. Inserts: Provide inserts or other anchoring devices in concrete and masonry construction as required to support raceways and equipment.

C. Openings: Where an opening is required in concrete slabs to allow passage of a multitude of raceways, give adequate notice to General Contractor so he may box out opening in form work.

D. Sleeves or openings through slabs for passage of future cables shall be located within 6 inches of walls and shall be in a single row and shall be proofed whether used or not.

E. Any openings through fire rated surfaces shall be closed off with fireproofing materials providing the same rating as the surface penetrated.

F. Acceptable Manufacturers:

Specified Technologies Inc.
Thomas & Betts
International Protective Coatings Corp.
3M Fire Protection Products
Dow Corning

2.06 WIRING DEVICES:

A. Receptacles: Receptacles shall be flush mounted. All devices to be of same manufacturer.

Acceptable Manufacturers:
Tamper Resistant
Twenty (20) ampere duplex grounding type NEMA 5 20R,
Cooper TR8300,
Pass and Seymour TR63

Leviton TBR20

Twenty (20) ampere ground fault interrupter, grounding type NEMA 5 20R,
Cooper VFG20
Pass and Seymour 2095TR

Twenty (20) ampere ground fault interrupter, grounding type NEMA 5 20R,
Cooper VFG20
Pass and Seymour 2095TR
Leviton X7899-T

Twenty (20) ampere ground fault interrupter, grounding type NEMA 5 20R,
Weather Resistant
Cooper TWRVGF20
Pass and Seymour 2095TRW
Leviton W7899-TRE

Non-tamper Resistant
Twenty (20) ampere duplex grounding type NEMA 5 20R,
Cooper CR20
Pass and Seymour 53621,
Leviton BR20

Twenty (20) ampere ground fault interrupter, grounding type NEMA 5 20R,
Cooper VFGF20
Pass and Seymour 2095TR,
Leviton 7599

Thirty (30) ampere, 250 volt NEMA 14 30R complete with plate,
Hubbell 9430-A,
Pass and Seymour 3864,
Eagle 1257 (4w flush).

Fifty (50) ampere, 250 volt NEMA 14 50R complete with plate,
Arrow Hart 7987,
General Electric 4181-3,
Hubbell 9450A,
Pass and Seymour 3894,
Eagle 1258 (4w flush)

B. Switches: 20 ampere,

Hubbell 1221,
Pass and Seymour 20AC 2,
Leviton 1221.
Prewired devices with pigtails acceptable

C. Composition material of wiring devices to be nylon with ivory finish.

D. Cover plates:

1. Ivory smooth.
2. Provide gaskets on all wiring device plates where devices are on walls separating conditioned and non-conditioned spaces.
3. On residential projects. Use weather-proof bell box with in-use cover
4. On commercial projects Extra-Duty box/covers shall be used per NEC 406.9(B)(1).

E. Dimmer Controls

1. All devices shall be UL listed specifically for the required loads (i.e., incandescent, fluorescent, magnetic low voltage, electronic low voltage). Manufacturer shall provide file card upon request. Universal dimmers are not acceptable.
2. All dimmers and switches shall incorporate an air gap switch. The air gap switch shall be capable of meeting all applicable requirements of UL 20 for air gap switches on incandescent dimmers.
3. All dimmers and switches shall provide power failure memory. Should power be interrupted and subsequently returned, the lights will come back on to the same levels set prior to the power interruption. Restoration to some other default level is not acceptable.
4. Dimmers and switches shall meet ANSI/IEEE Std. C62.41 1980, tested to withstand voltage surges of up to 6000V and current surges of up to 200A without damage.
5. Dimmers and switches shall meet the UL 20 limited short circuit test requirement for snap switches.
6. Dimmer shall provide a smooth and continuous Square Law dimming curve.
7. Dimmers shall be voltage regulated so that +10% variation in line voltage shall cause not more than +5% variation in load voltage when dimmer is operating at 40V (5% light output).
8. Dimmers, where ganged, shall be derated in accordance with manufacturer's instructions. Ratings in watts listed on the drawings are the derated ratings.
9. Dimmers shall be Lutron.

F. WI-300 Dual Relay Automatic Wall Switch

1. The passive infrared sensor shall be a completely self contained control system that replaces a standard toggle switch. Sensor shall have ground wire for safety. Switching mechanism shall be dual latching air gap relays, compatible with electronic ballasts, compact fluorescent, and inductive loads. Triac and other harmonic generating devices shall not be allowed.

2. Sensor shall be capable of detecting presence in the control area by detecting changes in the infrared energy. Small movements shall be detected, such as when a person is writing while seated at a desk.
3. To avoid false ON activations and to provide high sensitivity to minor motion, Pulse Count Processing and Detection Signature Analysis shall be used to examine the frequency, duration, and amplitude of the signal received by the sensor to respond only to those signals caused by human motion.
4. Sensor shall utilize mixed signal ASIC (application-specific integrated circuit) technology, which combines analog and digital processing into one chip package, to provide immunity to RFI and EMI.
5. Sensor shall utilize two isolated relays capable of simultaneously controlling independent lighting loads or circuits.
6. The primary relay shall utilize Zero Crossing Circuitry (patented) to increase the relay life, protect from the effects of inrush current, and increase the sensor's longevity.
7. Sensor shall utilize a temperature compensated, dual element sensor and a multi-element Fresnel lens.
8. Fresnel lens shall be a Poly IR 4 based material to offer superior filtering capability of competing light sources, such as the sun and other visible light sources. Lens shall have grooves facing in to avoid dust and residue build up which affects IR reception.
9. To assure detection at desktop uniformly across the space, sensor shall use 41 segment multi-element lens with 4 layers vertically, at 0°, 5°, 12°, and 30° and up to 19 layers horizontally.
10. Sensor shall cover up to 1000 sq ft for walking motion, with a field of view of 180 degrees.
11. Sensor shall have patented prism system which provides superior 180° coverage.
12. Sensor shall operate at 120 VAC or 277 VAC.
13. Sensor shall have no minimum load requirement and each relay shall be capable of switching from 0 to 800 watts incandescent or fluorescent or 1/6 hp @ 120 VAC, 60 Hz; and 0 to 1200 watts fluorescent or 1/3 hp @ 277 VAC, 60 Hz.
14. Sensor shall have a built-in light level feature that affects only the secondary relay and is trimpot adjustable from 10 to 150 footcandles that holds lighting off when the desired footcandle level is present.
15. For accuracy and consistency, sensor shall have a time delay adjustable with trimpot from 30 seconds to 30 minutes.
16. Sensor shall have sensitivity settings adjustable with trimpot.
17. Adjustments and mounting hardware shall be concealed under a removable, tamperproof cover to prevent tampering of adjustments and hardware.
18. For safety, sensor shall have a 100% off switch with no leakage current to the load.

19. For safety, in the event there is an open circuit in the AC line such as a ballast or lamp failure, the sensor shall automatically switch to OFF mode.
20. For normal operation, sensor shall have two positions only: OFF and AUTO.
21. Sensor shall not protrude more than 1 inch from the wall and shall blend in aesthetically.
22. Sensor lens shall be mounted on 8 posts within the lens cavity and be secured in place with a full frame backing retainer for additional strength and vandal resistance.
23. To ensure quality and reliability, sensor shall be manufactured by an ISO 9002 certified manufacturing facility and shall have a defect rate of less than 1/3 of 1%.
24. Sensor shall have standard 5 year warranty and shall be UL and CUL listed

G. DW-100 Dual Technology Wall Switch Sensor

1. Sensor shall be capable of detecting presence in the control area by detecting Doppler shifts in transmitted ultrasound and passive infrared heat changes.
2. Sensor shall utilize Dual Sensing Verification Principle for coordination between ultrasonic and PIR technologies to reduce likelihood of false operations.
3. For best results, sensor shall feature a trigger mode where the end-user can choose which technology will activate the sensor from off mode (initial), the type of detection that will reset the time delay (maintain), and the type of detection that will cause the sensor to be turned back on immediately after lights turned off due to lack of motion (re-trigger). Selection of technologies for initial, maintain, and re-trigger shall be done with DIP switches.
4. Sensor shall have its trigger mode factory preset to allow for quick installation in most applications. In this default setting, both technologies must occur in order to initially activate lighting systems. Detection by either technology shall maintain lighting on, and detection by either technology shall turn lights back on after lights were turned off for five seconds or less in automatic mode and 30 seconds or less in manual mode.
5. Sensor shall have four occupancy logic options for customized control to meet application needs.
6. Robotic test method as referred in the NEMA WD 7 guide shall be utilized for minor motion coverage verification.
7. Ultrasonic sensing shall be volumetric in coverage with a frequency of 40 KHz. It shall utilize Advanced Signal Processing which automatically adjusts the detection threshold dynamically to compensate for constantly changing levels of activity and air flow throughout controlled space.
8. The PIR technology shall utilize a temperature compensated, dual element sensor and a multi-element Fresnel lens. The lens shall be Poly IR4

material to offer superior performance in the infrared wavelengths and filter short wavelength IR, such as those emitted by the sun and other visible light sources. The lens shall have grooves facing in to avoid dust and residue build up which affects IR reception.

9. Sensor shall utilize SmartSet™ technology to optimize automatic time delay to fit occupant usage patterns. The use of SmartSet shall be selectable with a DIP switch.
10. Sensor shall utilize Zero Crossing circuitry to reduce stress on relay and therefore increase sensor life.
11. DW-100 sensor shall have no minimum load requirement and shall be capable of switching from 0 to 800 Watt incandescent; 0 to 800 Watt fluorescent or 1/6 hp @ 120 VAC, 50/60Hz; and 0 to 1200 Watt fluorescent @ 230/277 VAC, 50/60Hz.
12. DW-100-347 sensor shall have no minimum load requirement and shall be capable of switching from 0 to 1500 Watt fluorescent @ 347 VAC, 50/60Hz.
13. To blend in aesthetically, sensor shall not protrude more than 3/8" from the wall and utilize color-matched lens.
14. To assure detection at desktop level uniformly across the space, sensor shall have a 28 segment, two-level, Fresnel injection molded lens.
15. Sensor shall feature a walk-through mode, where lights turn off three minutes after the area is initially occupied if no motion is detected after the first 30 seconds, set by DIP switch.
16. To avoid false on activations and to provide immunity to RFI and EMI, Detection Signature Analysis shall be used to examine the frequency, duration, and amplitude of a signal, to respond only to those signals caused by human motion.
17. Sensor shall cover up to 1,000 sq. ft. for walking motion, with a field view of 180 degree.
18. Sensor shall have automatic-on or manual-on operation adjustable with DIP switch.
19. Sensor shall have a time delay that is adjusted automatically (with the SmartSet setting) or shall have a fixed time delay of five to 30 minutes, set by DIP switches.
20. In automatic mode, sensor shall be capable to automatically return to automatic-on after lights are turned off manually.
21. Sensor shall have the option for an audible warning that shall beep to warn the end-user before lights turn off automatically.
22. Each sensing technology shall have a LED indicator that remains active at all times in order to verify detection within the area to be controlled.
23. Sensor shall have a service switch to allow end-users to operate the sensor in the unlikely event of a failure; set by a trim pot.
24. Sensor shall be able to control incandescent, magnetic low voltage, electronic low voltage, and fluorescent loads.
25. Sensor shall have a built-in light level featuring simple, one-step daylighting setup that works from 8 to 180 footcandles.

26. Switching mechanism shall be a relay(s). Triac and other harmonic generating devices shall not be allowed. Sensor shall have ground wire and grounded strap for safety.
27. The Dual Technology wall switch sensor shall be a completely self contained control system that replaces a standard toggle switch.
28. To ensure quality and reliability, sensor shall be manufactured by an ISO 9002 certified manufacturing facility and shall have a defect rate of less than 1/3 of 1%.
29. Sensor shall have standard 5-year warranty and shall be UL and CUL listed.

H. DW-200 Dual Technology Dual Relay Wall Switch Sensor

1. Sensor shall be capable of detecting presence in the control area by detecting Doppler shifts in transmitted ultrasound and passive infrared heat changes.
2. Sensor shall utilize Dual Sensing Verification Principle for coordination between ultrasonic and PIR technologies to reduce likelihood of false operations
3. For best results, sensor shall feature a trigger mode where the end-user can choose which technology will activate the sensor from Off mode (initial), the type of detection that will reset the time delay (maintain), and the type of detection that will cause the sensor to be turned back On immediately after lights turned Off due to lack of motion (re-trigger). Selection of technologies for initial, maintain, and re-trigger shall be done with DIP switches.
4. Sensor shall have its trigger mode factory preset to allow for quick installation in most applications. In this default setting, both technologies must occur in order to initially activate lighting systems. Detection by either technology shall maintain lighting on, and detection by either technology shall turn lights back on after lights were turned off for 5 seconds or less in automatic mode and 30 seconds or less in manual mode.
5. Sensor shall have 4 occupancy logic options for customized control to meet application needs.
6. Robotic test method as referred in the NEMA WD 7 guide shall be utilized for minor motion coverage verification.
7. Ultrasonic sensing shall be volumetric in coverage with a frequency of 40 KHz. It shall utilize Advanced Signal Processing which automatically adjusts the detection threshold dynamically to compensate for constantly changing levels of activity and air flow throughout controlled space.
8. The PIR technology shall utilize a temperature compensated, dual element sensor and a multi-element Fresnel lens. The lens shall be Poly IR4 material to offer superior performance in the infrared wavelengths and filter short wavelength IR, such as those emitted by the sun and other visible light sources. The lens shall have grooves facing in to avoid dust and residue build up which affects IR reception.

9. Sensor shall utilize SmartSet™ technology to optimize automatic time delay to fit occupant usage patterns. The use of SmartSet shall be selectable with a DIP switch.
10. Sensor shall utilize Zero Crossing circuitry on both relays to reduce stress on relays and therefore increase sensor life.
11. Sensor shall utilize two relays capable of simultaneously controlling independent lighting loads or circuits. The secondary relay is isolated, allowing for two-circuit control.
12. Sensor shall have no minimum load requirement and shall be capable of switching from 0 to 800 Watt incandescent; 0 to 800 Watt fluorescent or 1/6 hp @ 120 VAC, 50/60Hz; and 0 to 1200 Watt fluorescent @ 230/277 VAC, 50/60Hz.
13. To blend in aesthetically, sensor shall not protrude more than 3/8" from the wall and utilize color-matched lens.
14. To assure detection at desktop level uniformly across the space, sensor shall have a 28 segment, 2 level, Fresnel injection molded lens.
15. Sensor shall feature a walk-through mode, where lights turn off 3 minutes after the area is initially occupied if no motion is detected after the first 30 seconds, set by a DIP switch.
16. To avoid false ON activations and to provide immunity to RFI and EMI, Detection Signature Analysis shall be used to examine the frequency, duration, and amplitude of a signal, to respond only to those signals caused by human motion.
17. Sensor shall cover up to 1,000 sq. ft. for walking motion, with a field view of 180 degree
18. Sensor shall have automatic-ON or manual-ON operation on both relays adjustable with DIP switch.
19. Sensor shall have the option for an audible warning that shall beep to warn the end-user before lights turn Off automatically.
20. Each sensing technology shall have a LED indicator that remains active at all times in order to verify detection within the area to be controlled.
21. Sensor shall have a service switch to allow end-users to operate the sensor in the unlikely event of a failure; set by a trim pot.
22. Sensor shall be able to control incandescent, magnetic low voltage, electronic low voltage, and fluorescent loads.
23. Sensor shall have a built-in light level featuring simple, one-step daylighting setup that works from 8 to 180 footcandles.
24. Switching mechanism shall be a relay(s). Triac and other harmonic generating devices shall not be allowed. Sensor shall have ground wire and grounded strap for safety.
25. The Dual Technology wall switch sensor shall be a completely self contained control system that replaces a standard toggle switch
26. To ensure quality and reliability, sensor shall be manufactured by an ISO 9002 certified manufacturing facility and shall have a defect rate of less than 1/3 of 1%.

27. Sensor shall have standard 5 year warranty and shall be UL and CUL listed

I. DT-300 360° Dual Technology Sensor

1. The Dual Technology sensor shall be capable of detecting presence in the control area by detecting doppler shifts in transmitted ultrasound and passive infrared heat changes.
2. Sensors shall use patent pending ultrasonic diffusion technology that spreads coverage to a wider area.
3. Sensor shall utilize Dual Sensing Verification Principle for coordination between ultrasonic and PIR technologies. Detection verification of both technologies must occur in order to activate lighting systems. Upon verification, detection by either shall hold lighting on.
4. Sensor shall have a retrigger feature in which detection by either technology shall retrigger the lighting system on within 5 seconds of being switched off.
5. Sensors shall be ceiling mounted with a flat, unobtrusive appearance and provide 360° coverage.
6. Ultrasonic sensing shall be volumetric in coverage with a frequency of 40 KHz. It shall utilize Advanced Signal Processing that automatically adjusts the detection threshold dynamically to compensate for changing levels of activity and airflow throughout controlled space.
7. To avoid false ON activations and to provide immunity to RFI and EMI, Detection Signature Analysis shall be used to examine the frequency, duration, and amplitude of a signal, to respond only to those signals caused by human motion.
8. The PIR technology shall utilize a temperature compensated, dual element sensor and a multi-element Fresnel lens. The lens shall be Poly IR4 material to offer superior performance in the infrared wavelengths and filter short wavelength IR, such as those emitted by the sun and other visible light sources. The lens shall have grooves facing in to avoid dust and residue build up which affects IR reception.
9. DT-300 and DT-305 sensors shall operate at 24 VDC/VAC and halfwave rectified and utilize a Watt Stopper power pack.
10. DT-355 shall incorporate a switching power supply for reduced power consumption; shall operate at 120/230/277/347 VAC, 50/60 Hz and shall not require a power pack.
11. Sensors shall utilize SmartSet™ technology to optimize time delay and sensitivity settings to fit occupant usage patterns. The use of SmartSet shall be selectable with a DIP switch.
12. Sensors shall have a time delay that is adjusted automatically (with the SmartSet setting) or shall have a fixed time delay of 5 to 30 minutes, set by DIP switch.

13. Sensors shall feature a walk-through mode, where lights turn off 3 minutes after the area is initially occupied if no motion is detected after the first 30 seconds.
14. The DT-300 and DT-355 sensors shall have a built-in light level sensor that works from 10 to 300 footcandles.
15. The DT-300 and DT-305 sensors shall have a manual on function that is facilitated by installing a momentary switch.
16. Sensors shall have eight occupancy logic options that give the ability to customize control to meet application needs.
17. The sensors shall feature terminal style wiring, which makes installation easier.
18. DT-300 sensor shall have an additional single-pole, double throw isolated relay with normally open, normally closed and common outputs. The isolated relay is for use with HVAC control, data logging, and other control options.
19. Each sensing technology shall have an LED indicator that remains active at all times in order to verify detection within the area to be controlled. The LED can be disabled for applications that require less sensor visibility.
20. To ensure quality and reliability, sensor shall be manufactured by an ISO 9002 certified manufacturing facility and shall have a defect rate of less than 1/3 of 1%.
21. Sensors shall have standard 5 year warranty and shall be UL and CUL listed.

J. DT-200 Wall/Ceiling(Corner mounted) Dual Technology Sensor

1. The Dual Technology sensor shall be capable of detecting presence in the control area by detecting doppler shifts in transmitted ultrasound and passive infrared heat changes.
2. Sensor shall utilize Dual Sensing Verification Principle for coordination between ultrasonic and PIR technologies. Detection verification of both technologies must occur in order to activate lighting systems. Upon verification, detection by either shall hold lighting on.
3. Sensor shall have a retrigger feature in which detection by either technology shall retrigger the lighting system on within 5 seconds of being switched off.
4. Ultrasonic sensing shall be volumetric in coverage with a frequency of 40 KHz. It shall utilize Advanced Signal Processing which automatically adjusts the detection threshold dynamically to compensate for constantly changing levels of activity and air flow throughout controlled space.
5. Sensor shall be capable of corner mounting to a wall or ceiling in order to eliminate detection through open doorways and outside of controlled area. To provide superior small motion detection and immediate activation upon entry, coverage of both technologies must be complete and overlapping throughout the controlled area.

6. To avoid false ON activations and to provide immunity to RFI and EMI, Detection Signature Analysis shall be used to examine the frequency, duration, and amplitude of a signal, to respond only to those signals caused by human motion.
7. Sensor shall operate at 24 VDC/VAC and half wave rectified and utilize a Watt Stopper power pack.
8. The PIR technology shall utilize a temperature compensated, dual element sensor and a multi-element Fresnel lens. The lens shall be Poly IR4 material to offer superior performance in the infrared wavelengths and filter short wavelength IR, such as those emitted by the sun and other visible light sources. The lens shall have grooves facing in to avoid dust and residue build up which affects IR reception.
9. The lens shall cover up to 2000 sq ft for walking motion when mounted at 10 ft and 1000 sq ft of desktop motion.
10. DT-200 sensors shall have an additional single-pole, double throw isolated relay with normally open, normally closed and common outputs. The isolated relay is for use with HVAC control, data logging, and other control options.
11. Sensors shall utilize SmartSet™ technology to optimize time delay and sensitivity settings to fit occupant usage patterns. The use of SmartSet shall be selectable with a DIP switch.
12. Sensors shall have a time delay that is adjusted automatically (with the SmartSet setting) or shall have a fixed time delay of 5 to 30 minutes, set by DIP switch.
13. Sensors shall feature a walk-through mode, where lights turn off 3 minutes after the area is initially occupied if no motion is detected after the first 30 seconds.
14. Sensor shall have an override ON function for use in the event of a failure.
15. Sensor shall have a built-in light level sensor that works from 10 to 300 footcandles.
16. Sensor shall have 8 occupancy logic options for customized control to meet application needs.
17. Sensor shall have a manual on function that is facilitated by installing a momentary switch.
18. Each sensing technology shall have an LED indicator that remains active at all times in order to verify detection within the area to be controlled. The LED can be disabled.
19. To ensure quality and reliability, sensor shall be manufactured by an ISO 9002 certified manufacturing facility and shall have a defect rate of less than 1/3 of 1%.
20. Sensor shall have standard 5 year warranty and shall be UL and CUL listed.

K. Special Power Packs & Supplies

1. AT-277 AT-120& Power Supplies

a. AT-120 and AT-277 power supplies shall provide a 24VDC, 800 mA output to power sensors (for installations where many sensors are used).
b. Power supply shall be housed in NEMA 1 enclosure.
c. To ensure quality and reliability, power supply shall be manufactured by an ISO 9002 certified manufacturing facility and shall have a defect rate of less than 1/3 of 1%.
d. Power supply shall have a 5 year warranty.
e. Power supply shall be UL and CUL listed.

2. Form C Power Packs A120C-P & A277C-P
   a. Form C power pack shall be a self contained transformer and relay module measuring 1.75” x 2.75” x 1.5”.
   b. For ease and speed of installation, Form C power pack shall have a 1/2” snap-in nipple for 1/2” knockouts and mounting on outside of enclosure.
   c. Form C power pack shall have single pole, double throw isolated relay with normally open and normally closed contacts.
   d. Form C power packs shall be UL 2043 plenum rated.
   e. Form C power packs shall have dry contacts capable of switching 8 amp ballast load N/O, 5 amp ballast load N/C, 5 amp incandescent load N/O, 3 amp incandescent N/C, 1 hp N/O, .25 hp N/C, @ 120 VAC, 60 Hz; 6 amp ballast load N/O, 3 amp ballast load N/C, 5 amp incandescent load N/O, 2.5 amp incandescent load N/C, 2 hp N/O, .5 hp N/C @ 277 VAC, 60 Hz.
   f. Form C power pack shall provide a 24VDC, 100mA output.
   g. To ensure quality and reliability, Form C power pack shall be manufactured by an ISO 9002 certified manufacturing facility and shall have a defect rate of less than 1/3 of 1%.
   h. Form C power pack shall have a 5 year warranty.
   i. Form C power pack shall be UL listed.
3. Relay Power Packs C120E-P & C277E-P
   a. The C Series (C120E-P and C277E-P) power packs shall have two relays and shall be capable of switching 20 amp ballast load, 13 amp incandescent, 1 hp @ 120 VAC, 60 Hz; 20 amp ballast @ 277 VAC, 60Hz per relay.
   b. C Series power packs shall provide a 24 VDC, 150 mA output.
   c. C Series power packs shall be housed in a 4” metal junction box with a 1/2” nipple assembly for easy mounting.
   d. To ensure quality and reliability, C Series power packs shall be manufactured by an ISO 9002 certified manufacturing facility and shall have a defect rate of less than 1/3 of 1%.
   e. C Series power packs shall have a 5 year warranty.
   f. C Series power packs shall be UL and CUL listed.

2.07 LIGHTING FIXTURES:

A. Provide lighting fixtures complete with lamps, ballasts, and other devices as required for a first class installation. Furnish Ceiling Subcontractor with instructions concerning openings necessary, and provide frames for NEMA standard ceiling types or special mounting frames, as may be required. Fixtures shall be supported independently of hung ceiling construction.

B. All specialized lamps to be of a type recommended by the fixture manufacturers in their photometric reports.

C. Provide universal arrows on all exit signs and punch out directions as shown on floor plans.

D. Pendant mounted fixtures shall be suspended by means of manufacturer's standard tube pendants with swivel aligner and canopy in finished areas or threaded rods in non public areas. Length of suspension method to be as required to mount fixtures at the elevations called for or as otherwise shown on drawings or architectural elevations.

E. Fixture types shall be as scheduled. The note on fixture schedule “Possibly Acceptable Alternate Manufacturers” means that the manufacturers listed have products which could be equal. The determination of “equal” will be determined based upon features of the product specified by catalog number. A sample of any proposed substitution will be required. Standard cataloged products have been selected. Fixtures specially manufactured for this particular project and not part of a manufacturer’s standard line will not be acceptable.

F. All light fixtures are to meet the IBC, Energy Code for that area by using COMcheck. All substituted fixtures are to be approved by the engineer and must have the wattage for each fixture in order for it to be reviewed.

2.08 ELECTRICAL POWER EQUIPMENT:

A. Motor Controls - Manual and magnetic:

1. Individually mounted magnetic starters shall be NEMA rated across the line type with thermal overload on each phase, single speed, two speed, or reduced voltage start as indicated.
2. Starters shall be of maintained contact type, of size and type required for particular motor horsepower and voltage. Minimum size starter to be size 1 FVNR, unless noted otherwise.
   a. Starters shall have OL reset button, green push to test type pilot light to indicate "ON", and "HAND OFF AUTO" switch in cover.
   b. Starters to have 120 volt control transformers with fused output being provided for those units operating on 277/480 volt system.

c. Provide Class 20 fixed heater overloads with auto/manual reset.
d. Provide four (4) sets of auxiliary contacts of convertible type N.O. to N.C. for each starter.
e. Motor starters shall have NEMA I enclosures. Those in wet locations shall be NEMA 3R.
f. Acceptable Manufacturers:
General Electric
Square D/Groupe Schneider
Siemens
Allen Bradley

3. Manual motor starters shall have pilot lights and shall be furnished with thermal overloads on each phase.

B. Motors: Each motor shall have disconnect switch and starter provided under this section. Starters which are a part of "factory assembled" control panel will be provided under section supplying equipment to be controlled but connected under this section.

1. Provide motor terminal boxes for each motor not furnished with same.

C. Disconnect Switches:

1. Disconnect (safety) switches shall conform to industrial standards of NEMA, be UL listed and shall be heavy duty type, quick make, quick break type with interlocking cover mechanism and provisions for padlocking switch handle in "OFF" position. Three pole toggle switches are not acceptable as substitute for disconnect switches.
2. Disconnect switches shall be of fused or unfused type as indicated with number of disconnecting poles indicated. The grounded conductor shall not be switched. Switches for use with current limiting fuses shall be rejection type and those used in conjunction with motors shall be horsepower rated. Provide oversize termination lugs if required by conductor size.
3. Enclosures shall be of proper NEMA type for intended location and shall be phosphate coated or equivalent code gauge galvanized sheet steel with ANSI #24 dark gray, baked enamel finish.
4. Acceptable Manufacturers:
General Electric
Westinghouse
Square D/Groupe Schneider
Siemens
Allen Bradley

D. Fuses:

1. Provide a complete set of fuses for each item of fusible type equipment. Fusible equipment furnished by other contractors will be complete with

fuses, unless noted otherwise on electrical drawings. Each fuse initially installed shall be provided with Bussmann SAMI-indicating fuse covers.

2. Turn over to authorized representative of Owner upon completion a spare set of fuses of each different type and ampere rating installed. These spares shall be bound with twine and tagged.
3. Secondary system fuses, rated at 600 volts or less, shall be UL listed and constructed in conformance with the applicable standards set forth by NEMA and ANSI. All fuses of a particular class shall be of same manufacturer.
4. All fuses in distribution panelboards and switchboards shall be class "L" above 600 amperes and class "RK1" for 600 amperes and below.
5. Main, Feeder, and Branch Circuits:
   a. Circuits 601 amperes and above shall be protected by (Bussmann type KRP C LOW PEAK) current limiting time delay fuses.
   b. Circuits 0 600 amperes shall be protected by (Bussmann "LOW PEAK" dual element), time delay current limiting fuses, LPN RK (250 volts), LPS RK (600 volts), UL class RK 1.
6. Acceptable Manufacturers:
   Bussmann, Division of McGraw
   Gould/Shawmut
   GEC ALSTHOM

2.09 GROUNDING SYSTEM:

A. All equipment and systems shall be grounded. Refer especially to NEC Section 250.52 Requiring Connections to Building Steel, Foundation, Water Service, and Interior Piping. Provide transformer pad grounding to be in accordance with utility company standards.

B. The grounded conductor shall be supplemented by an equipment grounding system.

C. The equipment grounding system shall be installed so all conductive items in close proximity to electrical circuits operate continuously at ground potential and provide a low impedance path for ground fault currents.

D. Grounding conductors shall be so installed as to permit shortest and most direct path to ground.

E. Maximum measured resistance to ground of 25.0 ohms shall not be exceeded (NFPA 70-, 250.53(A)(2)). Ground separately derived systems (dry type transformers) in accordance with Article 250.30 by grounding neutral to transformer ground lug and providing insulated grounding electrode conductor to nearest effectively grounded building steel or, if unavailable, to nearest available effectively grounded metal water pipe.

F. Equipment grounding conductors and straps shall be sized in compliance with Code Table 250.122.

G. Grounding conductors shall be insulated with green color. Grounding conductors for use on isolated ground receptacles shall be green with trace color to differentiate between normal ground conductors.

H. Branch circuits shall consist of phase and grounded conductor installed in common metallic raceway. The raceway system may not serve as the grounding conductor. All circuits shall have a separate insulated grounding conductor installed. Any flexible cable system or non metallic raceway system shall have an insulated grounding conductor. Any cable system for use on isolated ground circuits shall have both an isolated ground conductor as well as an equipment ground conductor, both of which shall be insulated.

I. Each electrical expansion fitting shall be furnished with a bonding jumper. Provide grounding bushings and ground connections for all raceways terminating below equipment where there is no metal to metal continuity.

J. Continuity between all metallic and non metallic raceway systems and equipment shall be maintained.

K. Outdoor lighting fixtures shall be grounded and bonded in common with building system via a separate grounding conductor.

2.10 PANELBOARDS:

A. Panelboards shall be dead front, door in door safety type equipped with single or multi pole circuit breakers suitable for 120/208 volt, 3-phase, 4-wire operation.

B. Buses may be aluminum. Panelboards shall have a circuit directory card mounted in a frame with plastic cover on inside of door. Panelboards to have a copper ground bus with terminals for each circuit. Panelboards serving isolated ground receptacles shall have a separate ground bus for terminations of the isolated grounds. The isolated ground bus shall be mounted to the panel tub via non conducting means with a separate grounding conductor run to the normal panel ground bus. Provide oversize lugs for any termination requiring same due to oversize conductors.

C. Cabinets shall be minimum of 20 inches wide and be made of code gauge steel. Surface type shall be ordered without knockouts.

D. Trims shall be made of code gauge steel, surface or flush as indicated. Panelboards shall be keyed alike. Trims shall be provided with full-length piano hinge on one side, and secured to tub with sufficient quantity of latches opposite

the hinge side to allow trim to fit flush with tub and when released, allow full access to wiring gutters. Inner door shall allow access to circuit breakers only.

E. Panelboards shall be of the following types with minimum circuit breaker frame sizes listed below. Refer to schedules for larger circuit breaker frame sizes due to fault current availability.

1. 120/208 volt, three-phase, four-wire. Style:

General Electric type AQ	HHQB Breakers (bolt on)
Cutler Hammer type PRL 1	BAB Breakers (bolt on)
Siemens type CDP 7	BQ Breakers (bolt on)

2. Distribution Panels
   a. Where scheduled as circuit breaker type, symmetrical interrupting capacity 22,000 AIC.

General Electric type CCB	THED Breakers
Square D I Line type	FA Breakers
Siemens SPP	FXD6 Breakers

   b. Where scheduled as fusible type,

General Electric type QMR	35"width minimum
Cutler Hammer type PRL 4F	36"width minimum
Square D type QMB	35"width minimum
Siemens FPP type	38"width minimum

2.11 ELECTRIC SERVICE:

A. Coordinate and cooperate with Eversource, hereinafter called utility company, with respect to providing service and metering. See allowances section for back charges by utility company with respect to permanent service.

B. Provide all primary system raceways, elbows, pull wires and all pad grounding. Utility company will provide pad-mounted transformers, primary switches, and primary conductors including making up of all terminations and connections.

C. Provide secondary service complete including all conductors, raceways, and connectors at transformer. Provide oversize lugs if required due to conductor sizing. Attachment of secondary conductors to the transformer terminals will be done by utility company.

D. General Contractor shall do all excavation and back filling (in accordance with utility company standards) and shall construct the reinforced concrete pads for transformers.

E. All work to be done in accordance with utility company standards.

F. Metering: All usage will be on one secondary meter. Utility Company will furnish current transformers and potential transformers to be installed in

switchboard by contractor. Empty raceway with pull wire from the C/T compartment to the meter backboard shall be provided the e.c..

2.12 TELEPHONE/DATA SYSTEMS

A. Telephone system instruments and interconnecting wiring will be provided by the electrical contractor. Data system outlets and interconnecting wiring will be provided by the electrical contractor.

B. Provide raceways for both systems as indicated on drawings, including pull wires for both site underground distribution and raceway links between low-tension closets and rooms.

C. Raceway stubups at backboards to be located as indicated on the drawings. Provide a double duplex receptacle and a #6 AWG green insulated ground connection adjacent to the conduit stub up at incoming backboard.

D. Area above hung ceiling is a return air plenum. Telephone and data systems shall either be installed in conduit or shall be UL listed plenum cable.

E. Sleeves or openings thru slabs to allow for future cable installation shall be located within 6 inches of walls and shall be in a single row.

F. For each telephone outlet or data outlet indicated on the drawings, provide an appropriate flush outlet box. In insulated partitions, provide a ¾" raceway stub-up terminating with bushing to above nearest accessible hung ceiling. For furred hollow partitions, provide pull wire to above ceiling.

2.13 STANDBY ELECTRICAL SYSTEMS

A. Available Manufacturers:

1. Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

2. Manufacturers: Subject to compliance with requirements, provide products by one of the following.

3. Basis-of-Design Product: The design is based on a Cummins Power Generation engine/generator set Model 500 (DFEK). Any changes to the design based on other manufacturers will be the responsibility of the installing contractor at no additional cost. Proposals by other manufacturers must include a line-by-line compliance statement based on this specification and submitted with proposal.

4. Acceptable Manufacturers:
   a. Cummins Power Generation

b. Generac
c. Kohler

B. ENGINE-GENERATOR SET

1. General Specifications: The synchronous three phase generator shall be a single bearing, self-ventilated, drip-proof design in accordance with NEMA MG 1 and directly connected to the engine flywheel housing with a flex coupling. A permanent magnet (PMG) type generator shall be furnished. .

2. Digital Voltage Regulator: The digital voltage regulator shall be microprocessor based with fully programmable operating and protection characteristics. The regulator shall maintain generator output voltage within +/- .5% for any constant load between no load and full load. The regulator shall be capable of sensing true RMS in three phases of alternator output voltage, or operating in single phase sensing mode..

3. Motor Starting: Alternator shall be capable of accepting maximum (920) kVA in a single step and be capable of recovering to a minimum of 90% of rated no load voltage. Following the application of the specified kVA load at near zero power factor applied to the generator set.

4. Circuit Breaker Specifications: Provide a generator mounted 80% rated circuit breaker, molded case with solid state trip as sown on drawings.

5. Mounting Frame: Maintain alignment of mounted components without depending on concrete foundation; and have lifting attachments.

   a. Rigging Diagram: Inscribed on metal plate permanently attached to mounting frame to indicate location and lifting capacity of each lifting attachment and generator-set center of gravity.

C. Generator-Set Performance for Sensitive Loads:

1. Oversizing generator compared with the rated power output of the engine is permissible to meet specified performance.

   a. Nameplate Data for Oversized Generator: Show ratings required by the Contract Documents rather than ratings that would normally be applied to generator size installed.
2. Steady-State Voltage Operational Bandwidth: 1 percent of rated output voltage from no load to full load.
3. Transient Voltage Performance: Not more than 10 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within 0.5 second.
4. Steady-State Frequency Operational Bandwidth: Plus or minus 0.25 percent of rated frequency from no load to full load.
5. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.

6. Transient Frequency Performance: Less than 2-Hz variation for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within three seconds.
7. Output Waveform: At no load, harmonic content measured line to neutral shall not exceed 2 percent total with no slot ripple. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50 percent.
8. Sustained Short-Circuit Current: For a 3-phase, bolted short circuit at system output terminals, system shall supply a minimum of 300 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to winding insulation or other generator system components.
9. Excitation System: Performance shall be unaffected by voltage distortion caused by nonlinear load.

10. Provide permanent magnet excitation for power source to voltage regulator.

11. Start Time: Comply with NFPA 110, Type 10, system requirements.

D. ENGINE

1. Genset Requirements: The generator set shall be Standby Duty rated at 300 ekW, 375kVA, 1800 RPM, 0.8 power factor, 208 V, 3-Phase, 60 hertz, including radiator fan and all parasitic loads. Generator set shall be sized to operate at the specified load at a maximum ambient of 40ºC (104°F).

2. Material and Parts: All materials and parts comprising the unit shall be new and unused.The engine shall be diesel fueled, four (4) cycle, water-cooled, while operating with nominal speed not exceeding 1800 RPM. The generator set shall be EPA factory certified for stationary emergency use and comply with all state and local Codes / Ordinances at the time of installation and commissioning. This shall include, but not be limited to, engine exhaust emissions and sound emissions.

E. Rated Engine Speed: 1800 rpm.

1. Maximum Piston Speed for Four-Cycle Engines: 2250 fpm (11.4 m/s).
2. Lubrication System: The following items are mounted on engine or skid:
3. Filter and Strainer: Rated to remove 90 percent of particles 5 micrometers and smaller while passing full flow.
4. Thermostatic Control Valve: Control flow in system to maintain optimum oil temperature. Unit shall be capable of full flow and is designed to be fail-safe.
5. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps, siphons, special tools, or appliances.

F. Engine Fuel System:

a. Main Fuel Pump: Mounted on engine. Pump ensures adequate primary fuel flow under starting and load conditions.

G. Coolant Jacket Heater: Electric-immersion type, factory installed in coolant jacket system. Comply with NFPA 110 requirements for Level 1 equipment for heater capacity.

H. Governor: Adjustable isochronous, with speed sensing. Overspeed shutdown control for protection against overspeeding, control shall be solid state type and product of the engine manufacturer.

I. Cooling System: Closed loop, liquid cooled, with radiator factory mounted on engine-generator-set mounting frame and integral engine-driven coolant pump.

1. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.
2. Size of Radiator: Adequate to contain expansion of total system coolant from cold start to 110 percent load condition.
3. Expansion Tank: Constructed of welded steel plate and rated to withstand maximum closed-loop coolant system pressure for engine used. Equip with gage glass and petcock.
4. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer. Radiator cooling designed for 50°C ambient
5. Coolant Hose: Flexible assembly with inside surface of nonporous rubber and outer covering of aging-, ultraviolet-, and abrasion-resistant fabric.

    a. Rating: 50-psig (345-kPa) maximum working pressure with coolant at 180 deg F (82 deg C), and noncollapsible under vacuum.
    b. End Fittings: Flanges or steel pipe nipples with clamps to suit piping and equipment connections.

J. Muffler/Silencer: Critical type, sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed engine manufacturer's engine backpressure requirements.

K. Air-Intake Filter: Heavy-duty, engine-mounted air cleaner with replaceable dry-filter element and "blocked filter" indicator.

L. Starting System: 12 or 24-V electric, with negative ground.

i. Components: Sized so they will not be damaged during a full engine-cranking cycle with ambient temperature at maximum specified in Part 1 "Project Conditions" Article.
ii. Cranking Motor: Heavy-duty unit that automatically engages and releases from engine flywheel without binding.
iii. Cranking Cycle: As required by NFPA 110 for system level specified.
iv. Battery: Adequate capacity within ambient temperature range specified in Part 1 "Project Conditions" Article to provide specified cranking cycle at least three times without recharging.
v. Battery Cable: Size as recommended by engine manufacturer for cable length indicated. Include required interconnecting conductors and connection accessories.
vi. Battery Compartment: Factory fabricated of metal with acid-resistant finish and thermal insulation.
vii. Thermostatically controlled heater: arrange to maintain battery above 10 deg C regardless of external ambient temperature within range specified in Part 1 "Project Conditions" Article.

viii. Include accessories required to support and fasten batteries in place.
ix. Battery-Charging Alternator: Factory mounted on engine with solid-state voltage regulation.
x. Battery Charger: Current-limiting, automatic-equalizing and float-charging type. Unit shall comply with UL 1236 and include the following features:

a. Operation: Equalizing-charging rate of 10 A shall be initiated automatically after battery has lost charge until an adjustable equalizing voltage is achieved at battery terminals. Unit shall then be automatically switched to a lower float-charging mode and shall continue to operate in that mode until battery is discharged again.
b. Automatic Temperature Compensation: Adjust float and equalize voltages for variations in ambient temperature from minus 40 deg C to plus 60 deg C to prevent overcharging at high temperatures and undercharging at low temperatures.
c. Automatic Voltage Regulation: Maintain constant output voltage regardless of input voltage variations up to plus or minus 10 percent.
d. Ammeter and Voltmeter: Flush mounted in door. Meters shall indicate charging rates.
e. Safety Functions: Sense abnormally low battery voltage and close contacts providing low battery voltage indication on control and monitoring panel. Sense high battery voltage and loss of ac input or dc output of battery charger. Either condition shall close contacts that provide a battery-charger malfunction indication at system control and monitoring panel.
f. `Enclosure and Mounting: NEMA 250, Type 1, wall-mounted cabinet.

M. FUEL OIL STORAGE

1. Comply with NFPA 30.

2. Base-Mounted Fuel Oil Tank: Factory installed and piped, complying with UL 142 fuel oil tank. Features include the following:

i. Tank level indicator.
ii. Capacity: Fuel for 24 hours' continuous operation at 100 percent rated power output. **Must have full tank for testing.**
iii. Vandal-resistant fill cap.
iv. Containment Provisions: Comply with requirements of authorities having jurisdiction.
v. Mechanical reading fuel gauge.
vi. Low fuel level alarm contact.
vii. Fuel tank rupture alarm contact.

N. CONTROL AND MONITORING

1. Automatic Starting System Sequence of Operation: When mode-selector switch on the control and monitoring panel is in the automatic position, remote-control contacts in one or more separate automatic transfer switches initiate starting and stopping of generator set. When mode-selector switch is switched to the on position, generator set starts. The off position of same switch initiates generator-set shutdown. When generator set is

running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms. Operation of a remote emergency-stop switch also shuts down generator set.

2. Manual Starting System Sequence of Operation: Switching on-off switch on the generator control panel to the on position starts generator set. The off position of same switch initiates generator-set shutdown. When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms. Operation of a remote emergency-stop switch also shuts down generator set.

3. Configuration: Operating and safety indications, protective devices, basic system controls, and engine gages shall be grouped in a common control and monitoring panel mounted on the generator set. Mounting method shall isolate the control panel from generator-set vibration.

4. Indicating and Protective Devices and Controls:

   i. AC voltmeter.
   ii. AC ammeter.
   iii. AC frequency meter.
   iv. DC voltmeter (alternator battery charging).
   v. Engine-coolant temperature gage.
   vi. Engine lubricating-oil pressure gage.
   vii. Running-time meter.
   viii. Ammeter-voltmeter, phase-selector switch(es).
   ix. Generator-voltage adjusting rheostat.
   x. Start-stop switch.
   xi. Overspeed shutdown device.
   xii. Coolant high-temperature shutdown device.
   xiii. Coolant low-level shutdown device.
   xiv. Oil low-pressure shutdown device.
   xv. Fuel tank derangement alarm.
   xvi. Fuel tank high-level shutdown of fuel supply alarm.
   xvii. Generator overload.

5. Supporting Items: Include sensors, transducers, terminals, relays, and other devices and include wiring required to support specified items. Locate sensors and other supporting items on engine or generator, unless otherwise indicated.

6. Common Remote Audible Alarm: Signal the occurrence of any events listed below without differentiating between event types. Connect so that after an alarm is silenced, clearing of initiating condition will reactivate alarm until silencing switch is reset.

   i. Engine high-temperature shutdown.
   ii. Lube-oil, low-pressure shutdown.
   iii. Overspeed shutdown.
   iv. Remote emergency-stop shutdown.
   v. Engine high-temperature prealarm.
   vi. Lube-oil, low-pressure prealarm.
   vii. Fuel tank, low-fuel level.

viii. Low coolant level.

7. Remote Alarm Annunciator: Comply with NFPA 99. An LED labeled with proper alarm conditions shall identify each alarm event and a common audible signal shall sound for each alarm condition. Silencing switch in face of panel shall silence signal without altering visual indication. Connect so that after an alarm is silenced, clearing of initiating condition will reactivate alarm until silencing switch is reset. Cabinet and faceplate are surface- or flush-mounting type to suit mounting conditions indicated.

8. Remote Emergency-Stop Switch: Flush; wall mounted, unless otherwise indicated; and labeled. Push button shall be protected from accidental operation.

O. GENERATOR OVERCURRENT AND FAULT PROTECTION

1. The alternator shall be provided with an overcurrent protection relay that is UL-listed under category NRGU. The overcurrent protection system shall be coordinated with the thermal damage curve of the specific alternator provided. Submit thermal damage curve for alternator and protection curve (and settings if applicable) for the overcurrent protective system.

2. Generator Circuit Breaker: Molded-case, thermal-magnetic type; 80 percent rated; complying with NEMA AB 1 and UL 489.

   i. Tripping Characteristic: Designed specifically for generator protection.
   ii. Trip Rating: Matched to generator rating.
   iii. Mounting: Adjacent to or integrated with control and monitoring panel.

P. GENERATOR, EXCITER, AND VOLTAGE REGULATOR

1. Comply with NEMA MG 1.
2. Drive: Generator shaft shall be directly connected to engine shaft. Exciter shall be rotated integrally with generator rotor.
3. Electrical Insulation: Class H
4. Temperature Rise: 80ºC at 40°C ambient
5. Stator-Winding Leads: Brought out to terminal box to permit future reconnection for other voltages if required.
6. Construction shall prevent mechanical, electrical, and thermal damage due to vibration, overspeed up to 125 percent of rating, and heat during operation at 110 percent of rated capacity.
7. Permanent Magnet Generator (PMG) shall provide excitation power for optimum motor starting and short circuit performance.
8. Enclosure: Dripproof.
9. Instrument Transformers: Mounted within generator enclosure.
10. Voltage Regulator: Solid-state type, separate from exciter, providing performance as specified. The voltage regulation system shall be microprocessor-controlled, 3-phase true RMS sensing, full wave rectified, and provide a pulse-width modulated signal to the exciter. No exceptions or deviations to these requirements will be permitted.
11. Strip Heater: Thermostatically controlled unit arranged to maintain stator windings above dew point.
12. Windings: Two-thirds pitch stator winding and fully linked amortisseur winding.

Q. OUTDOOR GENERATOR-SET ENCLOSURE

1. Description: A weatherproof, sound attenuated aluminum non-walk in type enclosure shall be provided to house the engine/generator and accessories. There shall be clearance around electrical equipment in compliance with the NEC, and the NFPA. The enclosure shall be manufactured by the engine generator manufacturer or an approved equal and conform to the following design criteria:
   i. Wind rating shall be 150 mph
   ii. Louvers: Equipped with bird screen to permit air circulation when engine is not running while excluding birds and rodents
   iii. Hinged Doors: With padlocking provisions. Restraint/Hold back hardware to prevent door to keep door open at 180 degrees during maintenance. Rain lips over all doors.
   iv. Exhaust System: Muffler Location: Within enclosure.
   v. Hardware: All hardware and hinges shall be stainless steel.
   vi. Mounting Base: Suitable for mounting on sub-base fuel tank or housekeeping pad.
   vii. A weather protective enclosure shall be provided which allows the generator set to operate at full rated load with a static pressure drop equal to or less than 0.5 inches of water
   viii. Inlet ducts shall include rain hoods
   ix. Engine Cooling Airflow through Enclosure: Housing shall provide ample airflow for engine generator operation at rated load in an ambient temperature of 50 deg C.
   x. Sound Performance: Reduce the sound level of the engine generator while operating at full rated load to a maximum of (75) dBA measured at any location 7 m from the engine generator in a free field environment.
   xi. For Generators 250KW & Above) - Provide an internally mounted and wired electrical distribution panel to serve the engine generator and enclosure; including:

R. VIBRATION ISOLATION DEVICES

1. Elastomeric Isolator Pads: Oil- and water-resistant elastomer arranged in multiple layers, molded with a nonslip pattern and galvanized-steel baseplates of sufficient stiffness for uniform loading over pad area, and factory cut to sizes that match requirements of supported equipment.

   i. Material: Bridge-bearing neoprene, complying with AASHTO M 251.
   ii. Durometer Rating: 50.
   iii. Number of Layers: Three.

S. FINISHES

1. Indoor and Outdoor Enclosures and Components: Manufacturer's standard finish over corrosion-resistant pretreatment and compatible primer.

T. SOURCE QUALITY CONTROL

1. Project-Specific Equipment Tests: Before shipment, factory test engine-generator set and other system components and accessories manufactured specifically for this Project. Perform tests at rated load and power factor. Include the following tests:

   i. Test components and accessories furnished with installed unit that are not identical to those on tested prototype to demonstrate compatibility and reliability.
   ii. Full load run.
   iii. Maximum power.
   iv. Voltage regulation.
   v. Transient and steady-state governing.
   vi. Single-step load pickup.
   vii. Safety shutdown.
   viii. Provide 14 days' advance notice of tests and opportunity for observation of tests by Owner's representative.
   ix. Report factory test results within 10 days of completion of test.

2.14 AUTOMATIC TRANSFER SWITCHES.

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Cummins Power Generation
   2. ASCO

B. Equipment specifications for this Project are based on automatic transfer switches manufactured by Cummins Power Generation.

C. Transfer switches utilizing molded case circuit breakers do not meet the requirements of this specification and will not be accepted.

D. GENERAL TRANSFER-SWITCH PRODUCT REQUIREMENTS

1. Provide transfer switches in the number and ratings that are shown on the drawings. Indicated Current Ratings: Apply as defined in UL 1008 for continuous loading and total system transfer.

2. Fault-Current Closing and Withstand Ratings: UL 1008 WCR ratings must be specifically listed as meeting the requirements for use with protective devices at installation locations, under specified fault conditions. Withstand and closing ratings shall be based on use of the same set of contacts for the withstand test and the closing test.

3. Solid-State Controls: All settings should be accurate to +/- 2% or better over an operating temperature range of - 40 to + 60 degrees C (- 40 to + 140 degrees F).

4. Resistance to Damage by Voltage Transients: Components shall meet or exceed voltage-surge withstand capability requirements when tested according to IEEE C62.41. Components shall meet or exceed voltage-impulse withstand test of NEMA ICS 1.

5. Electrical Operation: Accomplished by a non-fused, momentarily energized solenoid or electric motor operator mechanism, mechanically and electrically interlocked in both directions (except that mechanical interlock is not required for closed transition switches).

6. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.

   a. Switches using molded-case switches or circuit breakers, or insulated case circuit breaker components are not acceptable.
   b. Transfer switches shall be double-throw, electrically and mechanically interlocked, and mechanically held in the Source 1 and Source 2 positions.
   c. Main switch contacts shall be high-pressure silver alloy. Contact assemblies shall have arc chutes for positive arc extinguishing. Arc chutes shall have insulating covers to prevent inter-phase flashover.
   d. Contacts shall be operated by a high-speed electrical mechanism that causes contacts to open or close within three electrical cycles from signal.
   e. The transfer switch operation shall include the ability to switch to an open position (both sources disconnected) for the purpose of load shedding from the generator set.
   f. The power transfer mechanism shall include provisions for manual operation under load with the enclosure door closed. Manual operation may be electromechanical or mechanical, but must be coordinated with control function.
   g. Transfer switch shall be provided with flame retardant transparent covers to allow viewing of switch contact operation but prevent direct contact with components that could be operating at line voltage levels.
   h. The transfer switch shall include the mechanical and control provisions necessary to allow the device to be field-configured for operating speed. Transfer switch operation with motor loads shall be as is recommended in NEMA MG1.
   i. Transfer switches designated on the drawings as “4-pole” shall be provided with a switched neutral pole switched which is switched simultaneously with phase poles..
   j. Transfer switches designated on the drawings as “3-pole” shall have a full current-rated neutral bar with lugs.
   k. Transfer switches designated on the drawings as “isolation-bypass” switches shall meet the requirements of section 2.4 of this specification.
   l. Transfer switches designated on the drawings as “non-automatic” switches shall meet the requirements of section 2.5 of this specification.
   m. Transfer switches designated on the drawings as “closed transition” switches shall meet the requirements of section 2.6 of this specification.
   n. Transfer switches designated on the drawings as “service entrance” switches shall meet the requirements of section 2.7 of this specification.

E. Control: Transfer switch control shall be capable of communicating with the genset control, other switches and remote programming devices over a high-speed network interface.

F. Factory wiring: Transfer switch internal wiring shall be composed of pre-manufactured harnesses that are permanently marked for source and destination. Harnesses shall be connected to the control system by means of locking disconnect plug(s), to allow the control system to be easily disconnected and serviced without disconnecting power from the transfer switch mechanism

G. Terminals: Terminals shall be pressure type and appropriate for all field wiring. Terminal arrangement and cabinet space must be such that feeder conductors can enter from the top, side or bottom of the switch, at the installer's discretion. Control wiring shall be equipped with suitable lugs, for connection to terminal strips.

H. Enclosures: All enclosures shall be third-party certified for compliance to NEMA ICS 6 and UL 508, unless otherwise indicated:

1. The enclosure shall provide wire bend space in compliance to the latest version of NFPA70, regardless of the direction from which the conduit enters the enclosure.
2. Exterior cabinet doors shall provide complete protection for the system's internal components. Doors must have permanently mounted key-type latches. Bolted covers or doors are not acceptable.
3. Transfer switches shall be provided in enclosures that are third party certified for their intended environment per NEMA requirements.
4. Transfer switches mounted in a controlled indoor environment shall be provided in NEMA Type 1 enclosures (IEC type IP30).
5. Transfer switches installed indoors shall be NEMA Type 12 (IEC type IP61) if the Project environment requires dust-proof and/or drip-proof equipment.
6. Transfer switches located outdoors shall be supplied in NEMA Type 3R (IEC IP34) when dust-proof and/or rain-proof enclosures are required.
7. Transfer switches that are installed outdoors or in any other uncontrolled environment shall be supplied with NEMA Type 4 or 4X (stainless steel) enclosures (IEC IP65).

I. AUTOMATIC TRANSFER SWITCHES
1. Comply with requirements for Level 1 equipment according to NFPA 110.
2. Indicated current ratings:
   a. Refer to the Project drawings for specifications on the sizes and types of transfer switch equipment, withstand and closing ratings, number of poles, voltage and ampere ratings, enclosure type, and accessories.
   b. Main contacts shall be rated for 600 VAC minimum.
   c. Transfer switches shall be rated to carry 100% of rated current continuously in the enclosure supplied, in ambient temperatures of -40 to +60 degrees C (-40 to +140 degrees F), relative humidity up to 95% (non-condensing), and altitudes up to 10,000 feet (3000 meters).
3. Manual Switch Operation: The power transfer mechanism shall include provisions for manual operation under load with the enclosure door closed. Manual operation may be electromechanical or mechanical, but must be coordinated with control function
4. Relay Signal: Control shall include provisions for addition of a pre-transfer relay signal, adjustable from 0 to 60 seconds, to be provided if necessary for elevator operation, based on equipment provided for the project..
5. Control: Transfer switch control shall be provided with necessary equipment and software to communicate with the genset control, other transfer switches, remote annunciation equipment, and other devices over a high speed control network.
6. Neutral Switching: Transfer switches designated on the drawings as 4-pole shall be provided with a switched neutral pole. The neutral pole shall be of the same construction and have the same ratings as the phase poles. All poles shall be switched simultaneously using a common crossbar. Substitute equipment using overlapping neutral contacts is not acceptable.

7. Transfer switches that are designated on the drawings as 3-pole shall be provided with a neutral bus and lugs. The neutral bus shall be sized to carry 100% of the current designated on the switch rating.
8. The transfer switch physically located closest to the generator and not more than 50 ft (15 meters) away, except those served by generator paralleling equipment, shall be provided with a battery charger suitable for the requirements of the application and in compliance with NFPA 110 requirements for Level 1 systems. If no transfer switch is located within this distance, a battery charger shall be installed on the generator set.
9. Automatic Transfer Switch Control Features

    1. The transfer switch control system shall be configurable in the field for any operating voltage level up to 600 VAC. Voltage sensing shall be monitored based on the normal voltage at the site. Systems that utilize voltage monitoring based on standard voltage conditions that are not field configurable are not acceptable.
    2. All transfer switch sensing shall be configurable from an operator panel or from a Windows XP or later PC-based service tool. Designs utilizing DIP switches or other electromechanical devices are not acceptable.
    3. The transfer switch shall be configurable to accept a relay contact signal and a network signal from an external device for load shedding purposes. On receipt of this signal, the transfer switch shall switch to a neutral position when connected to Source 2. If Source 1 is available when the load-shed signal is received, the transfer switch shall connect to Source 1.
    4. The transfer switch shall be configurable to accept a relay contact signal and a network signal from an external device to prevent transfer to the generator service.
    5. The transfer switch shall provide a relay contact signal prior to transfer or re-transfer. The time period before and after transfer shall be adjustable in a range of 0 to 50 seconds.
    6. The control system shall be designed and prototype tested for operation in ambient temperatures from - 40 degrees C to + 60 degrees C (- 40 to +140 degrees F). It shall be designed and tested to comply with the requirements of the noted voltage and RFI/EMI standards.
    7. The control shall have optically isolated logic inputs, high isolation transformers for AC inputs and relays on all outputs, to provide optimum protection from line voltage surges, RFI and EMI.
    8. The transfer switch network monitoring equipment, when supplied, shall be provided with a battery-based auxiliary power supply to allow monitoring of the transfer switch when both AC power sources are non-operational. The battery power supply shall be monitored for proper condition, and the transfer switch shall include an alarm condition to indicate low battery condition.

J. Transfer Switch Control Panel: The transfer switch shall have a microprocessor-based control with a sealed membrane panel incorporating pushbuttons for operator-controlled functions, and LED lamps for system status indicators. The panel shall also include an alphanumeric display for detailed system information. Panel display and indicating lamps shall include permanent labels.

    1. The indicator panel LEDs shall display:

        2 Which source the load is connected to (Source 1 or Source 2)
        3 Which source or sources are available

4 When switch is not set for automatic operation, because the control is disabled or the bypass switch is in use
5 When the switch is in test/exercise mode

2. The indicator shall have pushbuttons that allow the operator to activate the following functions:

a. Activate pre-programmed test sequence
b. Override programmed delays, and immediately go to the next operation
c. Reset the control by clearing any faults
d. Test all of the LEDs by lighting them simultaneously

3. The alphanumeric digital display shall be vacuum fluorescent-type, clearly visible in both bright sunlight and no-light conditions over an angle of 120 degrees, and shall display the following:

a. AC voltage for all phases, normal and emergency
b. Source status: connected or not connected.
c. Load data, including voltage, AC current, frequency, KW, KVA, and power factor.

4. The display panel shall be password-protected, and allow the operator to view and make adjustments:

a. Set nominal voltage and frequency for the transfer switch
b. Adjust voltage and frequency sensor operation set points
c. Set up time clock functions
d. Set up load sequence functions
e. Enable or disable control functions including program transition
f. View real-time clock data, operation log (hours connected, times transferred, failures) and service history

K. Control Functions: Functions managed by the control shall include:

1. Software adjustable time delays:

a. Engine start (prevents nuisance genset starts in the event of momentary power fluctuation): 0 to 120 seconds (default 3 sec)
b. Transfer normal to emergency (allows genset to stabilize before load is transferred): 0 to 120 seconds (default 3 sec)
c. Re-transfer emergency to normal (allows utility to stabilize before load is transferred from genset): 0 to 30 minutes (default 3 sec)
d. Engine cooldown: 0 to 30 minutes (default 10 min)
e. Programmed transition: 0 to 60 seconds (default 3 sec)

2. Undervoltage sensing: three-phase normal, three-phase emergency source.

a. Pickup: 85 to 98% of nominal voltage (default 90%)
Dropout: 75 to 98% of nominal voltage (default 90%)
Dropout time delay: 0.1 to 1.0 seconds (default 0.5 sec)
Accurate to within +/- 1% of nominal voltage

3. Over-voltage sensing: three-phase normal, three-phase emergency source.

    a. Pickup: 95 to 99% of dropout setting (default 95%)
    b. Dropout: 105 to 135% of nominal voltage (default 110%)
    c. Dropout time delay: 0.5 to 120 seconds (default 3 sec)
    d. Accurate to within +/- 1% of nominal voltage

4. Over/under frequency sensing:

    a. Pickup: +/- 5 to +/-20% of nominal frequency (default 10%)
    b. Dropout: +/-1% beyond pickup (default 1%)
    c. Dropout time delay: 0.1 to 15.0 seconds (default 5 sec)
    d. Accurate to within +/- 0.2%

L. Control features shall include:

1. Programmable genset exerciser: A field-programmable control shall periodically start the generator, transfer the load to generator for a preset time, then re-transfer and shut down the generator after a preset cool-down period.

    a. Push-button programming control shall have a selection of eight different schedules for exercising generator, with or without load.

2. In event of a loss of power to the control, all control settings, real-time clock setting and the engine start-time delay setting will be retained.
3. The system continuously logs information including the number of hours each source has been connected to the load, the number of times transferred, and the total number of times each source has failed. An event recorder stores information, including time and date-stamp, for up to 50 events.
4. Transfer Override Switch: Overrides automatic re-transfer control so automatic transfer switch will remain connected to emergency power source regardless of condition of normal source. Pilot light to indicate override status.

M. Control Interface

1. Provide one set Form C auxiliary contacts on both sides, operated by transfer switch position, rated 10 amps 250 VAC.
2. Unassigned Auxiliary Contacts: Two normally open, 1-pole, double-throw contacts for each switch position, rated 10A at 240 VAC.

N. Engine Starting Contacts

1. One isolated and normally closed, and one isolated and normally open; rated 10A at 32 VDC minimum.

O. SERVICE ENTRANCE TRANSFER SWITCHES

1. Transfer switches must be specifically intended for service entrance applications, and labeled “Suitable for service entrance use only”

2. Transfer switch shall meet NEC requirements for emergency, legally required and standby applications as specified in UL 1008.

3. Entire transfer switch including enclosure must be listed and labeled to UL 1008; switches with only the mechanism listed are not acceptable.

4. Molded case circuit breaker must be UL 489 listed.

2.15 SURGE SUPPRESSION:

A. Furnish and install a transient voltage surge suppressor on the secondary side of each main service over-current device. Unit shall be designed, manufactured, tested and installed in compliance with the following standards:

American National Standards Institute and Institute of Electrical and Electronic Engineers (ANSI/IEEE C62.41 1991 and C62.45 1987)
Federal Information Processing Stds. (FIPS Pub 94)
National Electrical Manufacturers Association (NEMA)
National Fire Protection Association (NFPA 70)
National Electrical Code
U.L. 1449 Second Edition AUD 1283

B. Unit shall be connected on the load side of the service disconnect, and its feed shall be less than ten feet. Unit shall be IEEE Category “C3”. Protection modes: L-N, L-G, N-G. Surge current rating shall be as follows:

L-N	-	80,000
L-G	-	80,000
N-G	-	80,000

C. Maximum continuous operating voltage of all suppression components utilized shall not be less than 115% of the nominal voltage of 480/277V system.

D. Units shall have the following:

1. LED status indicators to display the operational status of each phase module.
2. Audible alarm to indicate failure of and phase protection module with lighted on/off alarm silence switch.
3. Surge counter to register all transients occurring above the system clamping voltage with push to reset button.
4. N.O. N.C. dry contact for interface with building management system. Contact must change state if any module fails on any phase.
5. Internal fused disconnect switch. Externally mounted fused disconnect acceptable at contractor's option.

E. Documentation and Testing

1. Furnish equipment manual with installation, operation and maintenance instructions for the specified unit.
2. Documentation of units U.L. 1449 clamping voltage with or without disconnect.
3. A list of customer replaceable spare parts.

F. Warranty

1. The manufacturer shall provide a minimum one (1) year replacement warranty from date of installation against failure.

G. Acceptable Manufacturers (If UL certified for 1449 – 2nd Edition)

Liebert
EFI
APT
Leviton
Current Technology
United Power

2.16 UNDERGROUND DUCTBANKS:

A. General: Furnish and install the ductbanks and extension of existing as herein specified and as shown on the drawings.

B. Division of Work:

1. The General Contractor shall be responsible for the work and material required for the following:
   a. Excavation
   b. Backfill
   c. Concrete envelope for conduits including reinforcing rods and tie down rods.
   d. Brick or concrete collars to bring manhole frames and covers up to grade. Installation of frames and collars, which are to be furnished by the Electrical Subcontractor.
2. All other material, equipment, and labor required for the complete ductbank extension shall be furnished and installed by the Electric Subcontractor under this Section, including the following:
   a. Service raceways.
   b. Grounding material.
   c. Detectable Ductbank warning tape. Equal to Ideal model, 42-251
   d. Pre-cast manholes.

C. Materials

1. Conduit: Type Schedule 40 PVC where installed in concrete envelope. See BASIC MATERIALS SECTION.
2. Conduit Supports (duct system): Shall be molded plastic with interlocking lugs and skeletonized structure, minimum separation 3".
3. Tags: Non-ferrous metal or fiber, ¼" high letters.
4. Warning tape shall be solid aluminum foil, 6" wide, as manufactured by Ideal Industries, and shall be installed above all ductbanks both high and low tension.

D. Duct System

1. The duct system shall consist of Schedule 40 PVC conduit encased in concrete except where otherwise specified. The size and number of conduits shall be as indicated on the drawings. Provide a pull wire in each conduit.
2. The entire length between manholes and end of ductbank shall be excavated and graded before any conduit is laid.
3. The ductbank shall be set on undisturbed earth.
4. The conduit shall be installed so that top of concrete is a minimum of 36" below finished grade unless otherwise indicated, and shall be laid to a minimum grade of 4" for each 100 feet of length. Duct system shall drain to manholes.
5. Changes in direction shall be made by long sweep bends, minimum radius 25 feet except that at the end of a run, within 10 feet of termination. Manufactured ends may be used having a minimum radius of 48 inches.
6. Conduit base and intermediate spacers shall be installed a maximum of 5 feet on centers. Spacers shall not be placed one above the other, but shall be staggered a minimum of 6".
7. All conduit joints shall be made watertight by means of a sealing compound before the coupling is installed. Joints in conduit shall be staggered, minimum space between joints in adjacent conduit shall be 6".
8. When the required number of conduits has been installed, securely tie the assembly together at distances not exceeding 7 feet. Tie shall consist of three (3) turns of No. 18 iron wire. Separate ties required for low tension and high tension conduit runs.
9. Duct envelope shall be of monolithic construction and shall be vibrated to eliminate voids.
10. Pouring of concrete shall be continuous throughout the length of construction. The end of the pour shall be interlocked or sloped. If the installation is halted, the ends of conduit shall be plugged.
11. Concrete shall not be poured until the conduit installation has been observed by the Architect.
12. Warning tape shall be installed during backfilling and shall be placed approximately 12" above the concrete encasement.

13. After the installation in completed, each conduit shall be cleaned and identified. A standard flexible mandrel and a stiff bristle brush shall be pulled through each conduit. The mandrel shall not be less than 12" long and the diameter approximately ¼" less than the conduit.
14. Manholes shall be furnished and installed by electrical Subcontractor. Provide frames and covers as indicated on the drawings.

2.17 HORIZONTAL CABLING – COPPER:

In addition to meeting the category 6 specifications outlined in ANSI/TIA/EIA-568-B.2-1, the requirements in this section must also be met for all applicable balanced twisted-pair products as listed below.

A. Outlets: All category 6 information outlets designed for termination of 4-pair balanced twisted-pair category 6 copper cable must possess the following characteristics at the minimum:

1. Be independently verified for category 6 compliance
2. Be available in black, white, red, gray, yellow, blue, orange, ivory, bright white, light ivory and alpine white
3. Have available a gravity feed (45 degree angled) design to help control patch cord bend radius as well as flush mount design
4. Utilizes TRI-BALANCE™ technology with optimized pair balance design and linear crosstalk response to address applications up to 250 MHz
5. Have 310 style insulation displacement connectors with quadrant pair isolation and a Pyramid™ wire entry system
6. Allow termination with a single conductor impact tool
7. Have available termination aid (included with each box of 20) for stabilization of module to facilitate lacing and impact during termination
8. Modules should feature category markings on front and rear of outlet
9. Be backwards compatible to allow lower performing categories of cables or connecting hardware to operate to their full capacity
10. Have rear protective strain relief caps with side or rear entry, which can be installed onto cable before or after termination
11. Support industry standards for T568A or T568B wiring options on each individual outlet
12. Allow installation from the front or rear of the faceplate, and allow for the jack to pass through the faceplate without re-termination
13. Be side-stackable for high-density solutions
14. Have a color matching protective, hinged or flexible door to protect the outlet from dust and other airborne contaminants
15. Provide color-coded, slide-in icons available for circuit identification
16. Allow for a minimum of 200 terminations without signal degradation below standards compliance limits
17. Be constructed of high impact, flame-retardant thermoplastic

18. Have, as an option, an outlet, which can be mounted into an IEC 60603-7 compliant opening (keystone)
19. Must be certified by Underwriters Laboratories to United States Standards.
20. Meet the following performance specifications:

Margin Over Category 6 @ 250MHz		
Parameters	**Worst Case**	**Typical**
Insertion Loss (dB)	0.12	0.14
NEXT* (dB)	0.84	4.37
FEXT* (dB)	2.1	5.1
Return Loss (dB)	6.9	8.3
* Tested in both Differential and Common modes		

B. Faceplates: All faceplates installed, as part of this specification shall have these minimum features listed below: Be applicable to both fiber and copper applications.

1. Be available in 1-, 2-, 3-, 4- and 6-port single-gang configurations or 6-, 8- and 12-port double-gang configurations.
2. Allow modules to be removed from the front of the faceplate.
3. Allow UTP modules to pass through faceplates even after termination.
4. Have write on designation labels for circuit identification together with a clear plastic cover.
5. Feature easily removable designation label covers which can be removed without use of tools.
6. Be available in single-gang and double-gang configurations.
7. Have as a minimum the standard colors of black, white, gray, ivory and light ivory.
8. Have optional modular furniture adapters available.
9. Have Designer style faceplates and mounting frames available
10. Have stainless steel versions available with designation label option.
11. Have surface mount boxes and standoff rings available for both single and double gang faceplates.
12. Be manufactured using UV resistant, high impact thermoplastic to prevent color fading and provide additional durability.
13. Must be certified by Underwriters Laboratories to United States Standards.

C. Patch Cords: All Category 6 modular equipment cords shall conform to the flowing minimum performance standards:

1. Be factory assembled and 100% transmission tested with laboratory grade network analyzers for proper performance up to 250 MHz
2. Be backwards compatible with lower performing categories
3. Be equipped with identical modular 8-position plugs on both ends, wired straight through with standards compliant wiring

4. Utilize patented metallic isolator shields pairs inside plug for optimum NEXT performance and a 360-degree crimp for providing excellent plug-to-cable strain relief without causing pair deformation
5. Obtain the required performance without use of printed circuit board components
6. Incorporate internal stranded cordage isolator within a round, flame-retardant jacket to provide extended flex life and maintain ideal pair geometry
7. Use bend relief compliant boots to ensure proper category 6 performance
8. Use modular plugs which exceed FCC CFR 47 part 68 subpart F and IEC 60603-7 specifications, have 50 micro-inches minimum of gold plating over nickel contacts and are resistant to corrosion from humidity, extreme temperatures, and airborne contaminants
9. Have a revolutionary patent-pending push-pull latch design for easy access and removal in high density patching environments
10. Be available in standard lengths of 3, 5, 7, 10, 15 and 20 ft. with custom lengths available upon request
11. Offer multiple cable colors (with color matching boots) in standard colors of black, white, red, gray, yellow, blue, and green for proper circuit identification
12. Be certified by Underwriters Laboratories to United States Standards.
13. Meet the following performance specifications:

Frequency (MHz)	Attenuation (dB/100m)	PS ELFEXT (dB)	PS NEXT (dB)
1	2.4	67.8	72.3
4	4.5	55.8	63.3
10	7.1	47.8	57.3
16	9.1	43.7	54.2
20	10.2	41.8	52.8
31.25	12.8	37.9	49.9
62.5	18.5	31.9	45.4
100	23.8	27.8	42.3
200	34.8	21.8	37.8
250	39.4	19.8	36.3

D. Copper Trunk Cables: The pre-terminated Cat6 copper trunk cables shall be assembled using 250MHz Cat6 information outlets and cable and must possess the following characteristics at the minimum:

1. Be Category 6 component compliant out to 250MHz
2. Be factory assembled and 100% transmission tested with laboratory grade network analyzers for proper performance up to 250MHz
3. Be backwards compatible with lower performing categories

4. Utilize high quality Premium 6 UTP cable available in CMR, CMP and LSOH jacket materials.
5. Be factory terminated and tested with Category 6 UTP information outlets.
6. Have each leg labeled for proper outlet orientation
7. Have a "straight cut" pattern to the trunk cable ends to create optimal cable orientation and to limit cable crossing.
8. Be available in standard lengths of 3m (9ft) to 90m (295ft) with custom lengths available upon request
9. Have each cable assembly coded with a unique identification number for administrative purpose.

E. Category 6, Twisted-Pair Cables (**plenum**): All qualified cables shall surpass the most severe category 6 requirements provided in the Industry Standards by meeting or exceeding the performance listed below for all specified frequencies (except where noted):

Parameter	UTP Cable Performance				
	100 MHz	**200 MHz**	**250 MHz**	**400 MHz***	**550 MHz***
Insertion Loss (dB)	19.0	27.5	31.0	40.0	47.7
NEXT Loss (dB)	51.3	46.8	45.3	42.3	40.0
PSNEXT Loss (dB)	49.3	44.8	43.3	40.0	38.2
ACR (dB)	32.3	19.3	14.4	2.3	-7.5
PSACR (dB)	30.3	17.3	12.4	0.3	-9.5
ACR-F (dB)	34.8	28.7	26.8	22.7	19.9
PS ACR-F (dB)	31.8	25.7	23.8	19.7	16.9
Return Loss (dB)	20.1	18.0	17.3	15.9	14.9
Propagation Delay (ns)	538	537	536	536	536
Delay Skew (ns)	≤ 45	≤ 45	≤ 45	≤ 45	≤ 45
* Performance for frequencies beyond TIA and ISO requirements are for information only Siemon Premium 6 Cable Recommended					

1. In addition to the requirements listed above, bundled or hybrid cable must also meet the following requirements:
   a. Be in groupings of 4-pair units.
   b. Be power sum NEXT tested where any disturbed pair within the hybrid/bundle cable shall be 3 dB better than the specified pair-to-pair NEXT loss of a single 4-pair cable of the same category.

F. RG-6/U Quad Shielded Cable:

2. Swept to 4.5 Ghz (HDTV).
3. 18 AWG Copper coated steel center conductor.
4. Type CL2. (In-wall rated.) UL Listed.
5. Shielding:

a. 1st Layer: Bonded Aluminum Foil-Polyester Tape-Aluminum Foil (Bonded Duofoil) shield
b. 2nd Layer: aluminum Braid shield with 60% shield coverage
c. 3rd layer: Aluminum Foil-Polyester Tape-Aluminum Foil (Duofoil) shield
d. 4th layer: aluminum Braid shield with 40% shield coverage

2.18 EQUIPMENT ROOMS:

A. Inter-connection using modular patch cords and shall conform to EIA standard, 19-inch relay rack mounting requirements:

1. Be made of black anodized aluminum available in 16-, 24-, 32-, 48- and 96-port configurations with optional 12-port version for mounting on 89 style bracket
2. Accommodate at least 24 ports for each rack mount space (1RMS = 44.5 mm [1.75 in.])
3. Utilizes TRI-BALANCE™ technology with optimized pair balance design and linear crosstalk response to address applications up to 250 MHz
4. Have 310 style insulation displacement connectors with quadrant pair isolation and a Pyramid™ wire entry system
5. Allow termination with a single conductor impact tool
6. Be backwards compatible to allow lower performing categories of cables or connecting hardware to operate to their full capacity
7. Have rear protective strain relief caps which can be installed onto cable before or after cable termination
8. Support industry standards for T568A or T568B wiring options on each individual outlet
9. Have modular outlets compliant with FCC CFR 47 part 68 subpart F and IEC 60603-7 with 50 micro-inches of gold plating over nickel contacts
10. Be fully enclosed front and rear for physical protection of printed circuit board
11. Have a rear cable management bar for strain relief included with each panel
12. Have individual port identification numbers permanently marked on both the front and rear of the panel
13. Display category performance markings on front of panel
14. Include adhesive circuit identification and color-coding designation strips with each panel
15. Provide self adhesive, clear label holders and white designation labels with the panel, with optional color labels available
16. Must be certified by Underwriters Laboratories to United States Standards Must meet the following performance specifications:

Margin over category 6 @ 250MHz		
Parameters	**Worst Case**	**Typical**
Insertion Loss (dB)	0.13	0.15
NEXT* (dB)	0.75	4.0
FEXT* (dB)	2.0	4.9
Return Loss (dB)	6.5	8.0
* Tested in both Differential and Common modes		

17. Siemon HD® 6 Patch Panel Recommended

B. Connecting Blocks: The connecting block shall facilitate cross-connection and/or inter-connection using patch cords. The 110 blocks shall possesses the following characteristics:

1. Be made of flame-retardant thermoplastic, with the base consisting of horizontal index strips for terminating up to 25-pairs of conductors.
2. Be available in 100-, 200-, and 300-pair sized field termination kits.
3. Have detachable stand-off legs on the 100-pair base, while non-detachable stand-off legs are available for the 200- and 300-pair bases.
4. Contain access openings for rear to front cable routing to the point of termination.
5. Have termination strips on the base to be notched and divided into 5-pair increments.
6. Have clear label holders with the appropriate colored inserts available for the wiring blocks. The insert labels provided with the product shall contain vertical lines spaced on 2-, 3-, 4- and 5-pair circuit sizes and shall not interfere with running, tracing or removing patch cords. Label holders must be capable of mounting between each row of connecting blocks.
7. Have bases available in 19” panels and high-density frame configurations for rack or wall mounting with cable management hardware.
8. Have connecting blocks used for either the termination of cross-connect (jumper) wire or patch cords. All connecting blocks shall have color-coded tip and ring designation markers and be of single piece construction.
9. Have connecting blocks with a minimum of 200 re-terminations without signal degradation below standards compliance limit.
10. Support wire sizes: Solid 22-26 AWG (0.64 mm - 0.40 mm), and 7-strand wires.
    a. Must be Communications Circuit Accessory Listed per Underwriters Laboratories Standard UL 1863.
    b. Meet the following performance specifications:

Parameters	Performance @ 100MHz
Insertion Loss	0.4 dB
NEXT	43.0 dB
FEXT	35.1 dB
Return Loss	20.0 dB

11. Siemon S110® Wiring Blocks Recommended.

C. Racks: For rack-mounted installations in a telecommunications room the installer shall use a 19-inch equipment rack.

1. Have 116.8 mm (4.6 in) by 152 mm (6 in) vertical cable channels as side rails in 2.1 m (7 ft) height.
2. Include vertical cable managers mounted on the front of the channels with hinged covers that can handle large quantities of cables and patch cords. Cable managers must retain cables even when covers are removed. Covers are modular in design, which eliminates the need to remove full-length covers for each patch cord change.
3. Have available additional vertical cable manager segments for mounting to the back of the Rack to provide additional cable management.
4. Have channels capable of utilizing and re-locating ten high capacity, reusable hook and loop cable managers available in bags of ten.
5. Have cable access holes on side rails, which allow cables to be routed between adjacent racks.
6. Have standard 19-inch ANSI/EIA-310-C mounting holes having a full 45 RMS on front and back of rails.
7. Have ladder channel, which acts as a top bracket to easily nest a standard 304.8 mm (12 in) ladder tray. The channel must have carriage bolt holes for attaching to the ladder system.
8. Have available an optional rack top cable tray which manages cable bundles routed above the rack, and eliminates the need for installing a ladder rack for routing cables. The tray is mounted without the need of tools or hardware and includes up to three (3) separate cable paths featuring removable quarter-turn hook and loop cable managers.
9. Be available in two versions, either aluminum or steel with a black finish and utilize black grommets for unused cable openings.
10. Have the mounting option of two additional vertical cable management channels 152 mm (6 in) x 2.1 m (7 ft) and 76 mm (3 in) x 2.1 m (7 ft) which can be located between racks. The channel shall include cable retainers, which can be hinged left or right and be located in any position along the channel.
11. Have floor mounting holes and a ground lug for 0-6 gauge ground cable provided.
12. Have optional 10-outlet (4 ft) power strip for mounting onto the rack.

13. Rack should be one of NSTAR's preferred vendor.

2.19 FIRE PROOFING

A. Provide through-penetration firestop systems that are compatible with one another, with the substrates forming openings, and with the items, if any, penetrating through-penetration firestop systems, under conditions of service and application, as demonstrated by through-penetration firestop system manufacturer based on testing and field experience.

B. Provide components for each through-penetration firestop system that are needed to install fill materials. Use only components specified by the firestopping manufacturer and approved by the qualified testing agency for the designated fire-resistance-rated systems.

C. This section includes through-penetration firestop systems for electrical equipment and penetrations through the following fire-resistance rated assemblies, including both blank openings and openings containing penetrating items such as conduits, cabling, cable trays and bus duct:

1. Floor-ceiling assemblies.
2. Roof-ceiling assemblies.
3. Walls and partitions.
4. Smoke barriers.
5. Construction enclosing compartmentalized areas.

D. Related Sections include the following:

E. Fire Test Requirements

1. ASTM E-814, "Fire Tests of Penetration Fire Stops".
2. ANSI/ UL1479, "Fire Tests of Through Penetration Firestops"
3. ASTM E-119, "Fire Tests of Building Construction and Materials".
4. ANSI/ UL263, "Fire Tests of Building Construction and Materials".
5. ASTM E-84, "Surface Burning Characteristics of Building Materials".
6. ANSI/ UL723, "Surface Burning Characteristics of Building Materials".

F. References

1. Underwriters Laboratories (UL) of Northbrook, IL "Fire Resistance Directory".
   a. Through Penetration Firestop Systems (XHEZ)
   b. Fill, Void or Cavity Materials (XHHW)
   c. Firestop Devices (XHJI)
   d. Forming Materials (XHKU)
2. All major building codes:

a. International Building Code published by ICC.

3. National Fire Protection Association (NFPA) of Quincy, MA “NFPA 101: Life Safety Code”.
4. National Fire Protection Association (NFPA) of Quincy, MA “NFPA 70: National Electrical Code”.

G. Performance Requirements

1. Provide products that upon curing, do not re-emulsify, dissolve, leach, breakdown or otherwise deteriorate over time from exposure to atmospheric moisture, sweating pipes, ponding water or other forms of moisture characteristic during and after construction.
2. Openings within walls and floors designed to accommodate cabling systems subjected to frequent cable changes shall be provided with re-enterable products specifically designed for retrofit.

H. Quality Assurance

1. Provide through-penetration firestop systems that comply with the following requirements and those specified in “Performance Criteria” Article:
   a. Firestopping tests are performed by a qualified, testing and inspection agency. A qualified testing and inspection agency is UL, or another agency performing testing and follow-up inspection services for firestop systems acceptable to authorities having jurisdiction.
   b. Through-penetration firestop system products bear classification marking of qualified testing and inspection agency.
2. Engage an experienced installer who is certified, licensed or otherwise qualified by the firestopping manufacturer as having been provided the necessary training to install firestop products per specified requirements. A manufacturer’s willingness to sell its through-penetration firestop system products to Contractor or to an installer engaged by Contractor does not in itself confer qualifications on buyer.
3. Obtain through-penetration firestop systems for each type of penetration and construction condition indicated from a single manufacturer.
4. Conduct conference at Project site to comply with requirements in Division 1 Section “Project Meetings”.

I. Acceptable Manufacturers

1. Subject to compliance with through-penetration firestop systems (XHEZ) listed in Volume 2 of the UL Fire Resistance Directory, provide products of the following manufacturers as identified below:
   a. Acceptable Manufacturer: Specified Technologies Inc., 200 Evans Way, Somerville, NJ 08876. Tel: (800) 992-1180, Fax: (908) 526-

9623, Email: specseal@stifirestop.com, Website: www.stifirestop.com.

b. Substitutions: Are permitted.

J. Materials

1. General: Use only through-penetration firestop system products that have been tested for specific fire-resistance-rated construction conditions conforming to construction assembly type, penetrating item type, annular space requirements, and fire-rating involved for each separate instance.
2. Latex Sealants: Single component latex formulations that upon cure do not re-emulsify during exposure to moisture, the following products are acceptable:
   a. Specified Technologies, Inc. (STI) SpecSeal Series SSS Intumescent Sealant
   b. Specified Technologies, Inc. (STI) SpecSeal Series LCI Intumescent Sealant
   c. Specified Technologies, Inc. (STI) SpecSeal Series LC Endothermic Sealant
   d. Specified Technologies, Inc. (STI) SpecSeal Series AS Elastomeric Spray
3. Firestop Devices: Factory-assembled steel collars lined with intumescent material sized to fit specific outside diameter of penetrating item, the following products are acceptable:
   a. Specified Technologies, Inc. (STI) SpecSeal Series SSC Firestop Collars
   b. Specified Technologies, Inc. (STI) SpecSeal Series LCC Firestop Collars
4. Firestop Putty: Intumescent, non-hardening, water resistant putties containing no solvents, inorganic fibers or silicone compounds, the following products are acceptable:
   a. Specified Technologies, Inc. (STI) SpecSeal Series SSP Firestop Putty
5. Firestop Putty Pads: Intumescent, non-hardening putty pads to be installed on metallic and nonmetallic electrical switch and receptacle boxes to reduce horizontal separation between boxes to less than 24”, the following products are acceptable:
   a. Specified Technologies, Inc. (STI) SpecSeal Series SSP Firestop Putty Pads
6. Wrap Strips: Single component intumescent elastomeric strips faced on both sides with a plastic film, the following products are acceptable:
   a. Specified Technologies, Inc. (STI) SpecSeal Series RED2 Wrap Strip
   b. Specified Technologies, Inc. (STI) SpecSeal Series BLU2 Wrap Strip

7. Firestop Pillows: Re-enterable, non-curing, mineral fiber core encapsulated with an intumescent coating contained in a flame retardant poly bag, the following products are acceptable:
   a. Specified Technologies, Inc. (STI) SpecSeal Series SSB Firestop Pillows
8. Mortar: Portland cement based dry-mix product formulated for mixing with water at Project site to form a non-shrinking, water-resistant, homogenous mortar, the following products are acceptable:
   a. Specified Technologies, Inc. (STI) SpecSeal Series SSM Firestop Mortar
9. Silicone Sealants: Moisture curing, single component, silicone elastomeric sealant for horizontal surfaces (pourable or nonsag) or vertical surface (nonsag), the following products are acceptable:
   a. Specified Technologies, Inc. (STI) SpecSeal SIL300 Silicone Firestop Sealant
   b. Specified Technologies, Inc. (STI) SpecSeal SIL300SL Self-Leveling Silicone Firestop Sealant
10. Silicone Foam: Multicomponent, silicone-based liquid elastomers, that when mixed, expand and cure in place to produce a flexible, non-shrinking foam, the following products are acceptable:
    a. Specified Technologies, Inc. (STI) Pensil 200 Silicone Foam
11. Composite Sheet: Intumescent material sandwiched between a galvanized steel sheet and steel wire mesh protected with aluminum foil, the following products are acceptable:
    a. Specified Technologies, Inc. (STI) SpecSeal CS Composite Sheet
12. Cast-In-Place Firestop Device: Single component molded firestop device installed on forms prior to concrete placement with totally encapsulated, tamper-proof integral firestop system and smoke sealing gasket, the following products are acceptable:
    a. Specified Technologies, Inc. (STI) SpecSeal CD Cast-In Firestop Device
13. Firestop Plugs: Re-enterable, foam rubber plug impregnated with intumescent material for use in blank openings and cable sleeves, the following products are acceptable:
    a. Specified Technologies, Inc. (STI) SpecSeal Series FP Firestop Plug
14. Fire-Rated T Rating Collar Device: Louvered steel collar system with synthetic aluminized polymer coolant wrap installed on metallic pipes where T Ratings are required by applicable building code requirements, the following products are acceptable:
    a. Specified Technologies, Inc. (STI) SpecSeal T-Collar Device
15. Fire-Rated Cable Grommet: Molded two-piece grommet made from plenum grade polymer with a foam inner core for sealing individual cable penetrations up to 0.27 in. (7 mm) diameter, the following products are acceptable:
    a. Specified Technologies, Inc. (STI) Ready Firestop Grommet

16. Fire Rated Cable Pathways: STI EZ-PATH™ Brand device modules comprised of steel raceway with intumescent foam pads allowing 0 to 100 percent cable fill, the following products are acceptable:
    a. Specified Technologies Inc. (STI) EZ-PATH™ Fire Rated Pathway

2.20 GENERATOR TEMPORARY CABINET

A. Scope:

1. Contractor shall furnish, deliver, install and test the generator tap boxes as specified herein and in accordance with the drawings. Shall be equal to Temp Tap, model IB4-208-3-1-1-S-C or approved equal

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Temp tap
2. Berthold
3. Lakeshore Electrical Corporation

C. Quality Assurance

1. Generator tap boxes shall be UL listed and labeled under the UL 1008 standard with a minimum 42KA withstand rating.

2. Generator tap box manufacturer shall provide a complete factory assembled and tested generator tap box.
3. Generator tap box installation shall meet all applicable NEC standards.

D. Submittals:

1. Contractor shall submit manufacturer’s drawings and data of generator tap boxes for Engineer’s approval prior to start of fabrication. Drawings and data shall include, as a minimum, dimensioned general arrangement drawings, UL listing information including UL control or file number, component data, mounting provisions, conduit entry locations and installation instructions.

E. Warranty:

1. Generator tap boxes shall be covered by manufacturer’s warranty for a minimum period of (1) one year after shipment from manufacturer.

F. General:

2. All equipment shall be new.

3. Generator tap box manufacturer must have produced and sold generator tap boxes as a standard product for a minimum of (2) years.
4. Contractor shall be responsible for the equipment until it has been installed and is finally inspected, tested and accepted in accordance with the requirements of this Specification.
5. Generator tap boxes shall be TempTap Inlet Boxes as manufactured by ESL Power Systems, Inc. or equal as approved by the Engineer.

G. Generator Tap Boxes:

1. Generator tap box shall consist of cam-style male connectors and grounding terminals, all housed within a padlockable enclosure.

2. Generator tap box enclosure shall be Type 3R, constructed of continuous seam-welded, powder coated galvanneal steel. The main access shall be through a hinged door that extends the full height of the enclosure. Access for portable generator cables with female cam-style plugs shall be via cable entry openings in the bottom of the enclosure. A hinged flap door shall be provided to cover the cable openings when cables are not connected; the hinged flap door shall allow cable entry only after the main access door has been opened. Enclosure shall be powder coated after fabrication; color shall be wrinkle gray RAL 7038.
3. Cam-style male connectors (inlets) shall be UL Listed single-pole separable type and rated 1600 amps at 208VAC. Cam-style male connectors shall be color coded. Cam-style male connectors shall be provided for each phase and for ground, and shall also be provided for neutral if required. The ground cam-style male connectors shall be bonded to the enclosure, and a ground lug shall be provided for connection of the facility ground conductor. None of the cam-style male connectors shall be accessible unless the main access door is open.

2.21 PANELBOARDS

A. Panelboards shall be as shown on the drawings. Refer to drawings for details regarding location of components, voltage and current rating of devices and other required details. Suitable for use as Service Entrance given compliance with NEC.

B. Lighting And Power Distribution Panels (Standard)

1. Furnish Siemens Industry Lighting Panelboards, Type P1.

2. NEMA PB 1, circuit breaker type.

a. Standard Lighting and Power Distribution

1) Main Lug Panels to be rated as indicated on the drawings. Main lugs shall be either removable or lay-in style

construction for panels up to 250 amps to facilitate connections.

2) Main circuit breaker panels to be rated as indicated on the drawings.

3. Standard lighting and power distribution panels (P1) shall be field convertible from Main Lug to Main Breaker with no increase in panel height. Field- addable mains (bussed connected) sub-feed breaker or feed-thru lug kits shall also be available, without utilizing any branch circuit space.

4. Interior shall be changeable from top to bottom feed and vice-versa, while maintaining readability of dead- front labeling on standard lighting and power distribution panels.

b. Lighting and Power Distribution (Custom) for applications requiring bus connected RC switches, split bus, special bussing size or material, special wire connectors and other than standard size enclosures or voltages or systems.

1. Furnish Siemens Industry Series Lighting Panelboards, Type P2.

2. NEMA PB 1, circuit breaker type.

a. Custom Lighting and Power Distribution

1) Main Lug Panels to be rated as indicated on the drawings.

2) Main Circuit Breaker panels to be rated as indicated on the drawings.

b. Distribution Panels

1. Furnish Siemens Industry Series Distribution Panelboards, Type P3, P4 and P5.

2. NEMA PB 1, circuit breaker or fusible switch type.

a. Distribution Panels

1) Main lug panels shall be rated as indicated on the drawings.

2) Main breaker panels shall be rated as indicated on the drawings.

3) Main switch shall be rated as indicated on the drawings with branch breakers less than or equal to 1200 amps, fusible switches less than or equal to 1200A.

b. Bussing

1. Copper sized in accordance with UL 67 standards for temperature rise.

c. Ground Bars

1. A copper equipment ground bar shall be provided.

d. Neutrals

1. [Neutral bussing shall have a lug for each outgoing branch requiring a neutral connection; P1 and P3 load side neutral connection lugs to be split with each side taking 50% of load neutral connections.

e. Enclosure

1. Boxes shall be fabricated from galvanized, galvaneal steel or protected against corrosion per the requirements of NEMA 250, UL 50 and UL50E. Box or panel interior shall have adjustable screws to provide easy alignment for flush mounted applications. Removable end walls to be blank.

2. Surfaces of the trim shall be properly cleaned and painted gray ANSI 61.

a. Trims

3. Trims for Lighting and Power distribution shall be as indicated on the drawings. It shall be fabricated from steel, painted with an ANSI-61 light gray finish and equipped with concealed hinges, flush lock and circuit directory cardholder. Trim shall have two separate supports designed to engage the box flange to stabilize and secure the trim during installation. Trim screws to be located behind the lockable door for tamper resistance. Optional trims may be hinged to the box, door in door.

4. Trims for Distribution Panels shall be as indicated on the drawings. It shall be fabricated from steel, painted with an ANSI-61 light gray finish. Optional trims may be hinged to the box, door in door.

a. Circuit Breakers

5. Molded case circuit breakers shall be bolt-on devices. Short circuit rating shall be amperes symmetrical based on the smallest rating on any circuit breaker installed in the panel. Molded case circuit breaker shall be of the quick-make, quick-break, trip-free, thermal magnetic Breaker ratings shall be as shown on the drawings.
6. Molded case circuit breakers shall be thermal-magnetic, quick-make, quick-break, trip free. Multi-pole breakers shall be common trip.
7. Provide circuit breaker accessories as indicated on the drawings or panel schedules.
8. Provide SWD rated breakers for all lighting branch circuits and UL Listed Type HACR for all air conditioning equipment branch breakers.

9. Provide a complete arc flash study of the entire electrical system from the point of incoming service to all panelboards. Labels shall include the arc flash boundary in feet, hazard category and a list of appropriate PPE.

2.22 FIRE ALARM PANEL (NOTIFIER)

A. Main Fire Alarm Control Panel or Network Node

1. Main FACP or network node shall be a NOTIFIER Model NFS2-3030 and shall contain a microprocessor based Central Processing Unit (CPU) and power supply. The CPU shall communicate with and control the following types of equipment used to make up the system: intelligent addressable smoke and thermal (heat) detectors, addressable modules, printer, annunciators, and other system controlled devices.
2. In conjunction with intelligent Loop Control Modules and Loop Expander Modules, the main FACP shall perform the following functions:

    a. Supervise and monitor all intelligent addressable detectors and monitor modules connected to the system for normal, trouble and alarm conditions.
    b. Supervise all initiating signaling and notification circuits throughout the facility by way of connection to addressable monitor and control modules.
    c. Detect the activation of any initiating device and the location of the alarm condition. Operate all notification appliances and auxiliary devices as programmed. In the event of CPU failure, all SLC loop modules shall fallback to degrade mode. Such degrade mode shall treat the corresponding SLC loop control modules and associated detection devices as conventional two-wire operation. Any activation of a detector in this mode shall automatically activate associated Notification Appliance Circuits.

B. System Capacity and General Operation

1. The FACP shall be capable of communicating on Noti-Fire-Net over a Local Area Network (LAN) or Wide Area Network (WAN) utilizing a peer-to-peer, inherently regenerative communication format and protocol. The network shall support communication speed up to 100 Mb and support up to 200 panels / nodes per network.
2. The Fire Alarm Control Panel shall include a full featured operator interface control and annunciation panel that shall include a backlit 640-character liquid crystal display, individual, color coded system status LEDs, and a QWERTY style alphanumeric keypad for the field programming and control of the fire alarm system. Said LCD shall also

support graphic bit maps capable of displaying the company name and logo of either the owner or installing company.

3. All programming or editing of the existing program in the system shall be achieved without special equipment and without interrupting the alarm monitoring functions of the fire alarm control panel.
4. The FACP shall be able to provide the following software and hardware features:

    a. Pre-signal and Positive Alarm Sequence: The system shall provide means to cause alarm signals to only sound in specific areas with a delay of the alarm from 60 to up to 180 seconds after start of alarm processing. In addition, a Positive Alarm Sequence selection shall be available that allows a 15-second time period for acknowledging an alarm signal from a fire detection/initiating device. If the alarm is not acknowledged within 15 seconds, all local and remote outputs shall automatically activate immediately.
    b. Smoke Detector Pre-alarm Indication at Control Panel: To obtain early warning of incipient or potential fire conditions, the system shall support a programmable option to determine system response to real-time detector sensing values above the programmed setting. Two levels of Pre-alarm indication shall be available at the control panel: alert and action.
    c. Alert: It shall be possible to set individual smoke detectors for pre-programmed pre-alarm thresholds. If the individual threshold is reached, the pre-alarm condition shall be activated.
    d. Action: If programmed for Action and the detector reaches a level exceeding the pre-programmed level, the control panel shall indicate an action condition. Sounder bases installed with either heat or smoke detectors shall automatically activate on action Pre-Alarm level, with general evacuation on Alarm level.
    e. The system shall support a detector response time to meet world annunciation requirements of less than 3 seconds.
    f. Device Blink Control: Means shall be provided to turn off detector/module LED strobes for special areas.
    g. NFPA 72 Smoke Detector Sensitivity Test: The system shall provide an automatic smoke detector test function that meets the sensitivity testing requirements of NFPA 72.
    h. Programmable Trouble Reminder: The system shall provide means to automatically initiate a reminder that troubles exist in the system. The reminder will appear on the system display and (if enabled) will sound a piezo alarm.
    i. On-line or Off-line programming: The system shall provide means to allow panel programming either through an off-line software utility program away from the panel or while connected and on-line. The system shall also support upload and download of programmed database and panel executive system program to a

Personal Computer/laptop. A single change to one CPU database shall not require a database download to other CPUs.

j. History Events: The panel shall maintain a history file of the last 4000 events, each with a time and date stamp. History events shall include all alarms, troubles, operator actions, and programming entries. The control panels shall also maintain a 1000 event Alarm History buffer, which consists of the 1000 most recent alarm events from the 4000 event history file.

k. The system shall provide means for all SLC devices on any SLC loop to be auto programmed into the system by specific address. The system shall recognize specific device type ID's and associate that ID with the corresponding address of the device.

l. Passwords and Users: The system shall support two password levels, master and user. Up to 9 user passwords shall be available, each of which may be assigned access to the programming change menus, the alter status menus, or both. Only the master password shall allow access to password change screens.

m. Block Acknowledge: The system shall support a block Acknowledge for Trouble Conditions

n. Sensitivity Adjust: The system shall provide Automatic Detector Sensitivity Adjust based on Occupancy schedules including a Holiday list of up to 15 days.

o. Environmental Drift Control: The system shall provide means for setting Environmental Drift Compensation by device. When a detector accumulates dust in the chamber and reaches an unacceptable level but yet still below the allowed limit, the control panel shall indicate a maintenance alert warning. When the detector accumulates dust in the chamber above the allowed limit, the control panel shall indicate a maintenance urgent warning.

p. Custom Action Messages: The system shall provide means to enter up to 100 custom action messages of up to 160 characters each. It shall be possible to assign any of the 100 messages to any point.

q. Local Mode: If communication is lost to the central processor the system shall provide added survivability through the intelligent loop control modules. Inputs from devices connected to the SLC and loop control modules shall activate outputs on the same loop when the inputs and outputs have been set with point programming to participate in local mode or when the type codes are of the same type: that is, an input with a fire alarm type code shall activate an output with a fire alarm type code.

r. Read status preview - enabled and disabled points: Prior to re-enabling points, the system shall inform the user that a disabled device is in the alarm state. This shall provide notice that the device must be reset before the device is enabled thereby avoiding activation of the notification circuits.

s. Custom Graphics: When fitted with an LCD display, the panel shall permit uploading of a custom bit-mapped graphic to the display screen.

t. Multi-Detector and Cooperating Detectors: The system shall provide means to link one detector with up to two detectors at other addresses on the same loop in cooperative multi-detector sensing. There shall be no requirement for sequential addresses on the detectors and the alarm event shall be a result of all cooperating detectors chamber readings.

u. ACTIVE EVENT: The system shall provide a Type ID called FIRE CONTROL for purposes of air-handling shutdown, which shall be intended to override normal operating automatic functions. Activation of a FIRE CONTROL point shall cause the control panel to (1) initiate the monitor module Control-by-Event, (2) send a message to the panel display, history buffer, installed printer and annunciators, (3) shall not light an indicator at the control panel, (4) Shall display ACTIVE on the LCD as well a display a FIRE CONTROL Type Code and other information specific to the device.

v. NON-FIRE Alarm Module Reporting: A point with a type ID of NON-FIRE shall be available for use for energy management or other non-fire situations. NON-FIRE point operation shall not affect control panel operation nor shall it display a message at the panel LDC. Activation of a NON-FIRE point shall activate control by event logic but shall not cause any indication on the control panel.

w. Mass Notification Override: The system shall be UL 2572 listed for Mass Notification and shall be capable, based on the Risk Analysis, of being programmed so that Mass Notification/Emergency Communications events take precedence over fire alarm events.

x. Security Monitor Points: The system shall provide means to monitor any point as a type security.

y. One-Man Walk Test: The system shall provide both a basic and advanced walk test for testing the entire fire alarm system. The basic walk test shall allow a single operator to run audible tests on the panel. All logic equation automation shall be suspended during the test and while annunciators can be enabled for the test, all shall default to the disabled state. During an advanced walk test, field-supplied output point programming will react to input stimuli such as CBE and logic equations. When points are activated in advanced test mode, each initiating event shall latch the input. The advanced test shall be audible and shall be used for pull station verification, magnet activated tests on input devices, input and output device and wiring operation/verification.

z. Control By Event Functions: CBE software functions shall provide means to program a variety of output responses based on various initiating events. The control panel shall operate CBE through lists of zones. A zone shall become listed when it is added to a point's zone map through point programming. Each input point such as detector, monitor module or panel circuit module shall support listing of up to 10 zones into its programmed zone map.

aa. Permitted zone types shall be general zone, releasing zone and special zone. Each output point (control module, panel circuit module) can support a list of up to 10 zones including general zone, logic zone, releasing zone and trouble zone. It shall be possible for output points to be assigned to list general alarm. Non-Alarm or Supervisory points shall not activate the general alarm zone.

bb. 1000 General Zones: The system shall support up to 1000 general purpose software zones for linking inputs to outputs. When an input device activates, any general zone programmed into that device's zone map will be active and any output device that has an active general zone in its map will be active. It shall also be possible to use general zone as arguments in logic equations.

cc. 1000 Logic Equations: The system shall support up to 1000 logic equations for AND, OR, NOT, ONLY1, ANYX, XZONE or RANGE operators that allow conditional I/O linking. When any logic equation becomes true, all output points mapped to the logic zone shall activate.

dd. 100 trouble equations per device: The system shall provide support for up to 100 trouble equations for each device, which shall permit programming parameters to be altered, based on specific fault conditions. If the trouble equation becomes true, all output points mapped to the trouble zone shall activate.

ee. Control-By-Time: A time based logic function shall be available to delay an action for a specific period of time based upon a logic input with tracking feature. A latched version shall also be available. Another version of this shall permit activation on specific days of the week or year with ability to set and restore based on a 24 hour time schedule on any day of the week or year.

ff. Multiple agent releasing zones: The system shall support up to 10 releasing zones to protect against 10 independent hazards. Releasing zones shall provide up to three cross-zone and four abort options to satisfy any local jurisdiction requirements.

gg. Alarm Verification, by device, with timer and tally: The system shall provide a user-defined global software timer function that can be set for a specific detector. The timer function shall delay an alarm signal for a user-specified time period and the control panel shall ignore the alarm verification timer if another alarm is detected during the verification period. It shall also be possible to

set a maximum verification count between 0 and 20 with the "0" setting producing no alarm verification. When the counter exceeds the threshold value entered, a trouble shall be generated to the panel.

hh. Secure/Access Operation: The system shall have the capability of configuring input modules to monitor status of door contact or other security type sensors. These input modules shall be able to be commanded from the normally 'Secure' state to an 'Access' state. While in the secure state, the module will transmit alarm conditions to the controller, which shall be annunciated on the LCD and LED displays. The modules shall be placed into the Access state either through the LCD display or through predefined operator keys. While in the Access state, all alarms from the module will be shunted. Placing the module into the access state shall cause a discrete LED associated with input point to flash, but no other trouble or disable condition will be annunciated. Change from Secure to Access and reverse shall be transmitted to the central monitoring station on a per zone basis. Systems that cause or indicate a trouble or disable condition are unacceptable.

5. Network Communication

   a. The FACP shall be capable of communicating on Noti-Fire-Net over a Local Area Network (LAN) or Wide Area Network (WAN) utilizing a peer-to-peer, inherently regenerative communication format and protocol. The network shall support communication speed up to 100 Mb and support up to 200 panels/nodes per network.

      1) The FACP shall be capable of communicating with a Distributed Control System

6. Central Processing Unit

   a. The Central Processing Unit shall contain and execute all control-by-event (including Boolean functions including but not limited to AND, OR, NOT, ANYx, and CROSSZONE) programs for specific action to be taken if an alarm condition is detected by the system. Such control-by-event programs shall be held in non-volatile programmable memory, and shall not be lost with system primary and secondary power failure.

   b. The Central Processing Unit shall also provide a real-time clock for time annotation, to the second, of all system events. The time-of-day and date shall not be lost if system primary and secondary power supplies fail.

c. The CPU shall be capable of being programmed on site without requiring the use of any external programming equipment. Systems that require the use of external programmers or change of EPROMs are not acceptable.
d. The CPU shall provide an EIA-232 interface between the fire alarm control panel and the UL Listed Electronic Data Processing (EDP) peripherals.
e. The CPU shall provide two EIA-485 ports for the serial connection to annunciation and control subsystem components.
f. The EIA-232 serial output circuit shall be optically isolated to assure protection from earth ground.

7. Display

a. The system display shall provide a 640-character backlit alphanumeric Liquid Crystal Display (LCD). It shall also provide eleven Light-Emitting-Diodes (LEDs) that indicate the status of the following system parameters: AC POWER, FIRE ALARM, PREALARM, SECURITY, SUPERVISORY, SYSTEM TROUBLE, OTHER EVENT, SIGNALS SILENCED, POINT DISABLED, CONTROLS ACTIVE, and CPU FAILURE.
b. The system display shall provide a QWERTY style keypad with control capability to command all system functions, entry of any alphabetic or numeric information, and field programming. Two different password levels with up to ten (one Master and nine User) passwords shall be accessible through the display interface assembly to prevent unauthorized system control or programming.

8. Loop (Signaling Line Circuit) Control Module:

a. The Loop Control Module shall monitor and control a minimum of 318 intelligent addressable devices. This includes 159 intelligent detectors (Ionization, Photoelectric, or Thermal) and 159 monitor or control modules.
b. The Loop Control Module shall contain its own microprocessor and shall be capable of operating in a local/degrade mode (any addressable device input shall be capable of activating any or all addressable device outputs) in the unlikely event of a failure in the main CPU.
c. Each SLC shall be capable of NFPA 72 Style 4, Style 6, or Style 7 (Class A or B) wiring. Fault isolation modules shall be installed between each addressable SLC device per the manufacturers installation instructions. Systems which cannot provide full loop loading in Style 7 configurations are not acceptable.
d. The SLC interface board shall receive analog or digital information from all intelligent detectors and shall process this information to

determine whether normal, alarm, or trouble conditions exist for that particular device. Each SLC Loop shall be isolated and equipped to annunciate an Earth Fault condition. The SLC interface board software shall include software to automatically maintain the detector's desired sensitivity level by adjusting for the effects of environmental factors, including the accumulation of dust in each detector. The analog information may also be used for automatic detector testing and the automatic determination of detector maintenance requirements.

9. Addressable Charger Power Supply

   a. The auxiliary addressable power supply is a remote 24 VDC power supply used to power Notification Devices and field devices that require regulated 24 VDC power; NOTIFIER model # ACPS-610
   b. The addressable power supply for the fire detection system shall provide up to a minimum of 6.0 amps of 24 volt DC regulated power for Notification Appliance Circuit (NAC) power or 10.0 amps of 24 volt DC general power. The power supply shall have an additional 0.5 amp of 24 VDC auxiliary power for use within the same cabinet as the power supply. It shall include an integral charger designed to charge 12 - 200 amp hour batteries.
   c. The addressable power supply shall provide four individually addressable Notification Appliance Circuits that may be configured as Class "A" or Class "B" circuits. All circuits shall be power-limited per UL 864 requirements.
   d. The addressable power supply shall provide built-in synchronization for certain Notification Appliances on each circuit without the need for additional synchronization modules. The power supply's output circuits shall be individually selected for synchronization. A single addressable power supply shall be capable of supporting both synchronized and non-synchronized Notification Devices at the same time.
   e. The addressable power supply shall operate on 120 or 240 VAC, 50/60 Hz.
   f. The interface to the power supply from the Fire Alarm Control Panel (FACP) shall be via the Signaling Line Circuit (SLC) or other multiplexed means Power supplies that do not use an intelligent interface are not suitable substitutes. The required wiring from the FACP to the addressable power supply shall be a single unshielded twisted pair wire.
   g. The addressable power supply shall supervise for battery charging failure, AC power loss, power brownout, battery failure, NAC loss, and optional ground fault detection. In the event of a trouble condition, the addressable power supply shall report the incident and the applicable address to the FACP via the SLC.

h. The addressable power supply shall have an AC Power Loss Delay option. If this option is utilized and the addressable power supply experiences an AC power loss, reporting of the incident to the FACP will be delayed. A delay time of zero, two, eight or sixteen hours shall be programmable.
i. The addressable power supply shall have an option for Canadian Trouble Reporting and this option shall be programmable.
j. The addressable power supply mounts in either the FACP backbox or its own dedicated surface mounted backbox with cover.
k. Each of the power supply's four output circuits shall be programmed- for Notification Appliance Circuit or General Purpose 24 VDC power. Any output circuit shall be able to provide up to 2.5 amps of 24 VDC power.
l. The addressable power supply's output circuits shall be individually supervised when they are selected to be either a Notification Appliance Circuit when wired Class "A" or by the use of and end-of-line resistor. When the power supply's output circuit is selected as General 24 VDC power, the circuit shall be individually supervised when an end-of-line relay is used.
m. When selected for Notification Appliance Circuits, the output circuits shall be individually programmable for Steady, March Time, Dual Stage or Temporal.
n. When selected as a Notification Appliance Circuit, the output circuits of the addressable power supply shall have the option to be coded by the use of a universal zone coder.
o. The addressable power supply shall interface and synchronize with other power supplies of the same type. The required wiring to interface multiple addressable power supplies shall be a single unshielded, twisted pair wire.
p. An individual or multiple interfaced addressable power supplies shall have the option to use an external charger for battery charging. Interfaced power supplies shall have the option to share backup battery power.

10. Remote Transmissions:

a. Provide local energy or polarity reversal or trip circuits as required.
b. The system shall be capable of operating a polarity reversal or local energy or fire alarm transmitter for automatically transmitting fire information to the fire department.
c. Provide capability and equipment for transmission of zone alarm and trouble signals to remote operator's terminals, system printers and annunciators.
d. Transmitters shall be compatible with the systems and equipment they are connected to such as timing, operation and other required features.

11. Field Programming

    a. The system shall be programmable, configurable and expandable in the field without the need for special tools, laptop computers, or other electronic interface equipment. There shall be no firmware changes required to field modify the system time, point information, equations, or annunciator programming/information.
    b. It shall be possible to program through the standard FACP keyboard all system functions.
    c. All field defined programs shall be stored in non-volatile memory.
    d. Two levels of password protection shall be provided in addition to a key-lock cabinet. One level shall be used for status level changes such as point/zone disable or manual on/off commands (Building Manager). A second (higher-level) shall be used for actual change of the life safety program (installer). These passwords shall be five (5) digits at a minimum. Upon entry of an invalid password for the third time within a one minute time period an encrypted number shall be displayed. This number can be used as a reference for determining a forgotten password.
    e. The system programming shall be "backed" up via an upload/download program, and stored on compatible removable media. A system back-up disk shall be completed and given in duplicate to the building owner and/or operator upon completion of the final inspection. The program that performs this function shall be "non-proprietary", in that, it shall be possible to forward it to the building owner/operator upon his or her request.
    f. The installer's field programming and hardware shall be functionally tested on a computer against known parameters/norms which are established by the FACP manufacturer. A software program shall test Input-to-Output correlations, device Type ID associations, point associations, time equations, etc. This test shall be performed on an IBM-compatible PC with a verification software package. A report shall be generated of the test results and two copies turned in to the engineer(s) on record.

12. Specific System Operations

    a. Smoke Detector Sensitivity Adjust: A means shall be provided for adjusting the sensitivity of any or all addressable intelligent detectors in the system from the system keypad. Sensitivity range shall be within the allowed UL window and have a minimum of 9 levels.
    b. Alarm Verification: Each of the intelligent addressable smoke detectors in the system may be independently selected and enabled to be an alarm verified detector. The alarm verification delay shall be programmable from 0 to 60 seconds and each detector shall be

able to be selected for verification. The FACP shall keep a count of the number of times that each detector has entered the verification cycle. These counters may be displayed and reset by the proper operator commands.

13. System Point Operations:

a. Any addressable device in the system shall have the capability to be enabled or disabled through the system keypad or video terminal.

b. System output points shall be capable of being turned on or off from the system keypad or the video terminal.

c. Point Read: The system shall be able to display the following point status diagnostic functions without the need for peripheral equipment. Each point shall be annunciated for the parameters listed:

1) Device Status.
2) Device Type.
3) Custom Device Label.
4) Software Zone Label.
5) Device Zone Assignements.
6) Analog Detector Sensitivity.
7) All Program Parameters.

d. System History Recording and Reporting: The fire alarm control panel shall contain a history buffer that will be capable of storing up to 4000 system events. Each of these events will be stored, with time and date stamp, until an operator requests that the contents be either displayed or printed. The contents of the history buffer may be manually reviewed; one event at a time, and the actual number of activations may also be displayed and or printed. History events shall include all alarms, troubles, operator actions, and programming entries.

e. The history buffer shall use non-volatile memory. Systems which use volatile memory for history storage are not acceptable.

f. Automatic Detector Maintenance Alert: The fire alarm control panel shall automatically interrogate each intelligent system detector and shall analyze the detector responses over a period of time.

g. If any intelligent detector in the system responds with a reading that is below or above normal limits, then the system will enter the trouble mode, and the particular Intelligent Detector will be annunciated on the system display, and printed on the optional system printer. This feature shall in no way inhibit the receipt of

alarm conditions in the system, nor shall it require any special hardware, special tools, or computer expertise to perform.

h. The system shall include the ability (programmable) to indicate a "pre-alarm" condition. This will be used to alert maintenance personal when a detector is at 80% of its alarm threshold in a 60 second period.

14. System Maintenance Analysis and Reporting

a. The system shall automatically track NFPA 72 installation and testing requirements for all addressable devices to ensure that every device is functionally tested upon installation and then periodically as required by the Code.
b. If after twelve months any device has not been functionally tested a led shall illuminate on the CPU or Network annunciator indicating the device that needs testing.
c. The system shall automatically track device testing to ensure that a visual inspection is performed at least semi-annually.
d. If after six months a device has not been indicated as "visually inspected" a led shall illuminate on the CPU or Network annunciator indicating the device that needs testing.
e. A hand-held IR tool may be used to interact with each SLC device to indicate that a visual inspection has been performed. The IR device will explicitly identify the device by loop and address to ensure the correct visual inspection has been performed.
f. A comprehensive report shall be available from the laptop programmer which shows a predictive report of all devices that have upcoming testing requirements. These reports shall be configurable as either 30, 60 or 90 day predictive, current status, and "all database."
g. Systems that do not automatically track the individual testing requirements of the field devices will not be accepted.

C. System Components

1. Conventional Aspirating Detection

a. An optional air aspiration detection system shall be available.
b. The aspirating system shall support multiple sensitivity settings.
c. The aspirating system shall operate from 24 VDC.
d. The aspirating system shall provide alarm and trouble relays used to activate a fire alarm control panel.

2. Aspiration System Interface:

a. The system shall be capable of supporting Interface Modules for integrating Vesda Aspiration detectors into SLC loop of the fire

alarm control panel. The Interface Module shall support up to 19 detectors detectors, each SLC loop shall support one interface module.

3. High-Level Aspiration System Interface:

   a. The system shall be capable of supporting a High Level Interface for Vesda Aspirating Detection Systems. The interface shall support up to 100 detectors and allow the fire alarm network to monitor and control events on the aspiration system.

4. Communicators

   a. The UDACT shall be compact in size, mounting in a standard module position of the fire alarm control cabinet. Optionally, the UDACT shall have the ability for remote mounting, up to 6,000 feet from the fire alarm control panel. The wire connections between the UDACT and the control panel shall be supervised with one pair for power and one pair for multiplexed communication of overall system status. Systems that utilize relay contact closures are not acceptable.
   b. The UDACT shall include connections for dual telephone lines (with voltage detect), per UL/NFPA/FCC requirements. It shall include the ability for split reporting of panel events up to two different telephone numbers.
   c. The UDACT shall be capable of transmitting events in 4+2, SIA, and Contact ID.
   d. Communication shall include vital system status such as:

      1) Independent Zone (Alarm, trouble, non-alarm, supervisory)
      2) Independent Addressable Device Status
      3) AC (Mains) Power Loss
      4) Low Battery and Earth Fault
      5) System Off Normal
      6) 12 and 24 Hour Test Signal
      7) Abnormal Test Signal (per UL requirements)
      8) EIA-485 Communications Failure
      9) Phone Line Failure

   e. The UDACT shall support independent zone/point reporting when used in the Contact ID format. In this format the UDACT shall support transmission of up to 3,064 points. This enables the central station to have exact details concerning the origin of the fire or response emergency.
   f. The UDACT shall be capable of being programmed with the same programming utility as the host FACP, and saved, edited and uploaded and downloaded using the utility. UDACT shall be

capable of being programmed online or offline. The programming utility shall also support upgrading UDACT operating firmware.

g. The UDACT shall be capable of generating Central Station reports providing detailed programming information for each point along with the central station point address.

h. An IP or IP/GSM Communicator option shall be available to interface to the UDACT and be capable of transmitting signals over the internet/intranet or Cellular (GSM) network to a compatible receiver.

D. Gateway & Webserver Options

1. Common Alerting Protocol (CAP) Gateway: The system shall support an optional CAP Gateway (Common Alerting Protocol). The CAP Gateway translates fire system messages to industry standard CAP messages for integration with CAP-compliant clients. A CAP gateway shall be available from the fire alarm control panel manufacturer.
2. LEDSIGN Gateway: The system shall support an optional and proprietary LEDSIGN Gateway to interface to LED signs that will automatically display emergency messages. The signs shall be capable of storing up to 100 messages that can be activated via system programming with the ability to be manually overridden. The Sign Gateway shall support up to 10 independent signs, each sign capable of playing an independent message. Multiple LEDSIGN Gateways can be used in network applications. An LEDSIGN gateway shall be available from the fire alarm control panel manufacturer.
3. BACnet Interface Gateway: The system shall be capable of being interfaced with BACNet compliant clients. A BACnet interface supporting BACnet/IP communication shall be available from the fire alarm control panel manufacturer.
4. MODbus Interface Gateway: The system shall be capable of being interfaced with MODbus compliant clients. A MODbus interface supporting MODbus/TCP communication shall be available from the fire alarm control panel manufacturer.
5. Noti-Fire-Net Gateway: The system shall support an IP based gateway to enable the panel or local Noti-Fire-Net to be connected to an ONYXWorks workstation via the Internet or Intranet. This gateway shall also support the ability to integrate the system to an interactive firefighter's display. The Noti-Fire-Net Gateway shall be available from the fire alarm control manufacturer.
6. Webserver: The system shall support a webserver allowing remote connection via the Internet or Intranet. Authorized users will have the ability to view panel/network history, event status and device properties. The webserver shall also support sending event information via email or text to up to 50 registered users, the webserver shall be available from the fire alarm control panel manufacturer.

7. Web Portal Interface: The system shall be capable of being interfaced with a web portal to integrate with Inspection and Service Manager utilities. The web portal and inspection and service manager utilities shall be available from the fire alarm control panel manufacturer.

E. System Components - Addressable Devices

1. Addressable Devices - General

i. Addressable devices shall provide an address-setting means using rotary decimal switches. Addressable devices that require the address be programmed using a programming utility are not an allowable substitute. Addressable devices shall use simple to install and maintain decade, decimal address switches. Devices shall be capable of being set to an address in a range of 001 to 159.

j. Addressable devices, which use a binary-coded address setting method, such as a DIP-switch, are not an allowable substitute. Addressable devices that require the address be programmed using a special tool or programming utility are not an allowable substitute.

k. Detectors shall be intelligent (analog) and addressable, and shall connect with two wires to the fire alarm control panel Signaling Line Circuits.

l. Addressable smoke and thermal detectors shall provide dual alarm and power/polling LEDs. Both LEDs shall flash green under normal conditions, indicating that the detector is operational and in regular communication with the control panel, and both LEDs shall be placed into steady red illumination by the control panel, indicating that an alarm condition has been detected. If required, the LED flash shall have the ability to be removed from the system program. An output connection shall also be provided in the base to connect an external remote alarm LED.

m. The fire alarm control panel shall permit detector sensitivity adjustment through field programming of the system. The panel on a time-of-day basis shall automatically adjust sensitivity.

n. Using software in the FACP, detectors shall automatically compensate for dust accumulation and other slow environmental changes that may affect their performance. The detectors shall be listed by UL as meeting the calibrated sensitivity test requirements of NFPA Standard 72.

o. The detectors shall be ceiling-mount and shall include a separate twist-lock base with tamper proof feature. Base options shall include a sounder base with a built-in (local) sounder rated at 85 DBA minimum, a relay base and an isolator base designed for Style 7 applications. The system shall also support an intelligent programmable sounder base, the programmable sounder base shall

be capable of providing multiple tones based on programming and at a minimum be capable of providing a Temp-4 tone for CO (Carbon Monoxide) activation and a Temp-3 tone for fire activations and be capable of being synchronized with other programmable sounder bases and common area notification appliances; 85 DBA minimum.

p. Detectors shall also store an internal identifying type code that the control panel shall use to identify the type of device (ION, PHOTO, THERMAL).

q. Detectors will operate in an analog fashion, where the detector simply measures its designed environment variable and transmits an analog value to the FACP based on real-time measured values. The FACP software, not the detector, shall make the alarm/normal decision, thereby allowing the sensitivity of each detector to be set in the FACP program and allowing the system operator to view the current analog value of each detector.

r. Addressable devices shall store an internal identifying code that the control panel shall use to identify the type of device.

s. A magnetic test switch shall be provided to test detectors and modules. Detectors shall report an indication of an analog value reaching 100% of the alarm threshold.

t. Addressable modules shall mount in a 4-inch square (101.6 mm square), 2-1/8 inch (54 mm) deep electrical box. An optional surface mount Lexan enclosure shall be available.

2. Addressable Manual Fire Alarm Box (manual station)

a. Addressable manual fire alarm boxes shall, on command from the control panel, send data to the panel representing the state of the manual switch and the addressable communication module status; NOTIFIER model # NBG-12LX. They shall use a key operated test-reset lock, and shall be designed so that after actual emergency operation, they cannot be restored to normal use except by the use of a key.

b. All operated stations shall have a positive, visual indication of operation and utilize a key type reset.

c. Manual fire alarm boxes shall be constructed of Lexan with clearly visible operating instructions provided on the cover. The word FIRE shall appear on the front of the stations in raised letters, 1.75 inches (44 mm) or larger.

3. Intelligent Photoelectric Smoke Detector: The intelligent photoelectric smoke detector shall be NOTIFIER model # FSP-851 and shall use the photoelectric (light-scattering) principal to measure smoke density and shall, on command from the control panel, send data to the panel representing the analog level of smoke density.

4. Intelligent VIEW® Laser Photo Smoke Detector: The intelligent laser photo smoke detector shall be a spot type detector, NOTIFIER model # FSL-751, that incorporates an extremely bright laser diode and an integral lens that focuses the light beam to a very small volume near a receiving photo sensor. The scattering of smoke particles shall activate the photo sensor.

    a. The laser detector shall have conductive plastic so that dust accumulation is reduced significantly.
    b. The intelligent laser photo detector shall have nine sensitivity levels and be sensitive to a minimum obscuration of 0.02 percent per foot.
    c. The laser detector shall not require expensive conduit, special fittings or PVC pipe.
    d. The intelligent laser photo detector shall support standard, relay, isolator and sounder detector bases.
    e. The laser photo detector shall not require other cleaning requirements than those listed in NFPA 72. Replacement, refurbishment or specialized cleaning of the detector head shall not be required.
    f. The laser photo detector shall include two bicolor LEDs that flash green in normal operation and turn on steady red in alarm.

5. Intelligent Ionization Smoke Detector: The intelligent ionization smoke detector shall be NOTIFIER model # FSI-851 and shall use the dual-chamber ionization principal to measure products of combustion and shall, on command from the control panel, send data to the panel representing the analog level of products of combustion.

6. Intelligent Thermal Detectors: The intelligent thermal detectors shall be NOTIFIER FST- series addressable devices rated at 135 degrees Fahrenheit (58 degrees Celsius) and have a rate-of-rise element rated at 15 degrees F (9.4 degrees C) per minute. A high heat thermal detector rated at 190 degrees Fahrenheit shall also be available. The thermal detectors shall connect via two wires to the fire alarm control panel signaling line circuit.

7. Intelligent Duct Smoke Detector: The smoke detector housing shall accommodate an intelligent photoelectric detector that provides continuous analog monitoring and alarm verification from the panel. When sufficient smoke is sensed, an alarm signal is initiated at the FACP, and appropriate action taken to change over air handling systems to help prevent the rapid distribution of toxic smoke and fire gases throughout the areas served by the duct system. The Intelligent Duct Smoke Detector shall support the installation of addressable Photoelectric detector capable or being tested remotely. The Intelligent Duct Detector housing shall be

model # DNR(W) and the remote test capable photoelectric smoke detector shall be NOTIFIER model # FSP-851R.

8. IntelliQuad™ Advanced Multi-Criteria Intelligent Detector

   a. Intelligent multi-criteria fire detector shall be a NOTIFIER model number FSC-851. Smoke detector shall be an addressable intelligent multi-criteria smoke detector. The detector shall be comprised of four sensing elements, including a photoelectric (light-scattering) particulate sensor, an electrochemical carbon monoxide (CO) sensor, a daylight-filtered infrared sensor and solid state thermal sensor(s) rated at 135°F (57.2°C). The device shall be able to indicate distinct smoke and heat alarms.
   b. The intelligent multi-criteria detection device shall include the ability to combine the signal of the photoelectric signal with other sensing elements in an effort to react quickly in the event of a fire situation. It shall also include the inherent ability to distinguish between a fire condition and a nuisance alarm condition. The product design shall be capable of selecting the appropriate sensitivity levels based on the environment type chosen by user in which it is installed (office, manufacturing, kitchen etc.) and then have the ability to automatically change the setting as the environment changes.
   c. The detector shall be capable of automatically adjusting its sensitivity by means of drift compensation and smoothing algorithms. The detector shall be capable of automatically adjusting its sensitivity by means of drift compensation and smoothing algorithms. The device shall provide unique signals to indicate when 20% of the drift range is remaining, when 100% of drift range is used, and when there is a chamber fault to show unit requires maintenance.
   d. The detector shall indicate CO trouble conditions including 6 months of sensor life remaining and sensor life has expired. The detector shall indicate a combined signal for any of the following: low chamber trouble, thermistor trouble, CO self-test failure, IR self-test failure, and freeze warning.
   e. The detectors shall provide address-setting means on the detector head using rotary switches. Because of the possibility of installation error, systems that use binary jumpers or DIP switches to set the detector address are not acceptable. The detectors shall also store an internal identifying code that the control panel shall use to identify the type of detector. Systems that require a special programmer to set the detector address (including temporary connection at the panel) are labor intensive and not acceptable. Each detector occupies any one of at least 99 possible addresses on the signaling line circuit (SLC) loop. It responds to regular polls from the system and reports its type and status.

f. The detectors shall provide a test means whereby they will simulate an alarm condition and report that condition to the control panel. Such a test may be initiated at the detector itself (by activating a switch) or initiated remotely on command from the control panel. There are three test methods: functional magnet, smoke entry aerosol, or direct heat method.

g. The detectors shall provide two LEDs to provide 360° visibility. The LEDs are placed into steady red illumination by the control panel indicating that an alarm condition has been detected. An output connection shall also be provided in the base to connect an external remote alarm LED, sounder base, and / or relay base (optional accessories). The external remote alarm can be interconnected to other sounder or relay bases for activating all devices in a space via a single alarming unit.

h. Two LEDs on the sensor are controlled by the panel to indicate sensor status. Coded signals, transmitted from the panel, can cause the LEDs to blink, latch on, or latch off. Refer to the control panel technical documentation for sensor LED status operation and expected delay to alarm.

i. The detectors shall be ceiling-mount and shall be plug-in mounted into a twist-lock base. These detectors shall be constructed of off-white UV resistant polymer and shall be detachable from the mounting base to simplify installation, service and maintenance. Mounting base wiring connections shall be made by means of SEMS screws. The detector shall allow pre-wiring of the base and the head shall be a plug-in type. Mounting base shall be mounted on junction box which is at least 1.5 inches (3.81 cm) deep. Mounting base shall be available to mount to standard junction boxes. Suitable boxes include:

10) 4.0" (10.16 cm) square box with and without plaster ring.
11) 4.0" (10.16 cm) octagonal box.
12) 3.5" (8.89 cm) octagonal box.
13) Single-gang box.

j. Meets Agency Standards

14) ANSI/UL 268 -Smoke Detectors for Fire Alarm Signaling Systems
15) CAN/ULC-S529- Smoke Detectors for Fire Alarm Systems
16) FM 3230-3250- Smoke Actuated Detectors for Automatic Fire Alarm Signaling

9. IntelliQuad™ PLUS Advanced Multi-Criteria Intelligent Fire/CO Detector

a. Advanced Multi-Criteria Fire/CO detector shall be NOTIFIER model # FCO-851 and shall be an addressable advanced multi-criteria smoke detector with a separate signal for carbon monoxide (CO) detection per UL 2075 standards.

b. The detector shall be comprised of four sensing elements, including a photoelectric (light-scattering) particulate sensor, an electrochemical CO sensor, a daylight-filtered infrared (IR) sensor and solid state thermal sensor(s) rated at 135°F (57.2°C). The device shall be able to indicate distinct smoke and heat alarms.

c. The advanced multi-criteria detection device shall include the ability to combine the signal of the photoelectric signal with other sensing elements in order to react quickly in the event of a fire situation. It shall also include the inherent ability to distinguish between a fire condition and a nuisance alarm condition. The detector shall be capable of selecting the appropriate sensitivity levels based on the environment type (office, manufacturing, kitchen, etc.) in which it is installed, and then have the ability to automatically change the setting as the environment changes.

d. The CO detector component shall be capable of a functional gas test using a canned test agent to test the functionality of the CO sensing cell.

e. The detector shall be capable of automatically adjusting its sensitivity by means of drift compensation and smoothing algorithms. The device shall provide unique signals to indicate when 20 percent of the drift range is remaining, when 100 percent of drift range is used, and when there is a chamber fault to show the unit requires maintenance.

f. The detector shall indicate CO trouble conditions, including six months of sensor life remaining and sensor life has expired. The detector shall indicate a combined signal for any of the following: low chamber trouble, thermistor trouble, CO self-test failure, IR self-test failure, and freeze warning.

g. The detector shall provide address-setting means on the detector head using rotary switches. Because of the possibility of installation error, systems that use binary jumpers or DIP switches to set the detector address are not acceptable. The detector shall also store an internal identifying code that the control panel shall use to identify the type of detector. Systems that require a special programmer to set the detector address (including temporary connection at the panel) are labor intensive and not acceptable. Each detector occupies any one of at least 159 possible addresses on the signaling line circuit (SLC) loop. It responds to regular polls from the system and reports its type and status.

h. The detector shall provide a test means whereby it will simulate an alarm condition and report that condition to the control panel. Such a test may be initiated at the detector itself (by activating a switch)

or initiated remotely on command from the control panel. There shall be four test methods: functional magnet, smoke entry aerosol, carbon monoxide aerosol or direct heat method.

i. The detector shall provide two LEDs to provide 360° visibility. The LEDs shall be placed into steady red illumination by the control panel indicating that an alarm condition has been detected. An output connection shall also be provided in the base to connect an external remote alarm LED. The detector must be capable of connecting to a sounder base that provides both temporal 3 and temporal 4 patterns for fire and CO alarm.

j. Two LEDs on the sensor shall be controlled by the panel to indicate sensor status. Coded signals, transmitted from the panel, shall cause the LEDs to blink, latch on, or latch off. Refer to the control panel technical documentation for sensor LED status operation and expected delay to alarm.

k. The detector shall be plug-in mounted into a twist-lock base. The detector shall be constructed of off-white, UV-resistant polymer and shall be detachable from the mounting base to simplify installation, service and maintenance. Mounting base wiring connections shall be made by means of SEMS screws. The detector shall allow pre-wiring of the base and the head shall be a plug-in type. The mounting base shall be mounted on a junction box that is at least 1.5 inches (3.81 cm) deep. The mounting base shall be available to mount to standard junction boxes. Suitable boxes include:

1) 4.0" (10.16 cm) square box with and without plaster ring.
2) 4.0" (10.16 cm) octagonal box.
3) 3.5" (8.89 cm) octagonal box.
4) Single-gang box.
5) Double-gang box

l. Meets Agency Standards

1) ANSI/UL 268 -Smoke Detectors for Fire Alarm Signaling Systems
2) CAN/ULC-S529- Smoke Detectors for Fire Alarm Systems
3) FM 3230-3250- Smoke Actuated Detectors for Automatic Fire Alarm Signaling
4) UL 2075 – Gas and Vapor Detector and Sensors – Systems Connected

10. Addressable Dry Contact Monitor Module

a. Addressable monitor modules shall be provided to connect one supervised IDC zone of conventional alarm initiating devices (any

N.O. dry contact device) to one of the fire alarm control panel SLCs. The addressable monitor module shall be NOTIFIER model # FMM-1 (Class A or B) or FMM-101 (Class B)

b. The IDC zone shall be suitable for Style D/Class A or Style B/Class B operation. An LED shall be provided that shall flash under normal conditions, indicating that the monitor module is operational and in regular communication with the control panel.
c. For difficult to reach areas, the monitor module shall be available in a miniature package and shall be no larger than 2-3/4 inch (70 mm) x 1-1/4 inch (31.7 mm) x 1/2 inch (12.7 mm). This version need not include Style D or an LED.
d. For multiple dry contact monitoring a module shall be available that provides 10 Style B or 5 Style D input circuits; NOTIFIER model # XP10-M.

11. Addressable Control Module

a. Addressable control modules shall be provided to supervise and control the operation of one conventional circuit of compatible Notification Appliances, 24 VDC powered, polarized audio/visual notification appliances; NOTIFIER model # FCM-1
b. The control module NAC may be wired for Style Z or Style Y (Class A/B) with a current rating of 2 Amps for Style Z and 3 Amps for Style Y;
c. Audio/visual power shall be provided by a separate supervised circuit from the main fire alarm control panel or from a supervised UL listed remote supply.
d. For multiple circuit control a module shall be available that provides 6 Style Y (Class B) or 3 Style Z (Class A) control circuits; NOTIFIER model # XP6-C.

12. Addressable Relay Module:

a. Addressable Relay Modules shall be available for HVAC control and other network building functions; NOTIFIER model # FRM-1.
b. The module shall provide two form C relays rated at up to 3 Amps resistive and up to 2.0 Amps inductive.
c. The relay coil shall be magnetically latched to reduce wiring connection requirements, and to insure that 100% of all auxiliary devices energize at the same time on the same pair of wires.
d. For multiple relay control a module shall be available that provides 6 programmable Form-C relays; NOTIFIER model # XP6-R.

13. Addressable Two-In / Two-Out Monitor/Relay Module:

a. An addressable Two-In / Two-Out module shall be available; NOTIFIER model # FDRM-1.

b. The two-in/two-out module shall provide two Class B/Style B dry-contact input circuits and two independent Form-C relays rated at up to 3 Amps resistive and up to 2.0 Amps inductive.

14. Isolator Module: Isolator modules shall be provided to automatically isolate wire-to-wire short circuits on an SLC Class A or Class B branch. The isolator module shall limit the number of modules or detectors that may be rendered inoperative by a short circuit fault on the SLC loop segment or branch. At least one isolator module shall be provided for each floor or protected zone of the building; NOTIFIER model # ISO-X.

a. If a wire-to-wire short occurs, the isolator module shall automatically open-circuit (disconnect) the SLC. When the short circuit condition is corrected, the isolator module shall automatically reconnect the isolated section.
b. The isolator module shall not require address-setting, and its operations shall be totally automatic. It shall not be necessary to replace or reset an isolator module after its normal operation.
c. The isolator module shall provide a single LED that shall flash to indicate that the isolator is operational and shall illuminate steadily to indicate that a short circuit condition has been detected and isolated.

15. Serially Connected Annunciator Requirements

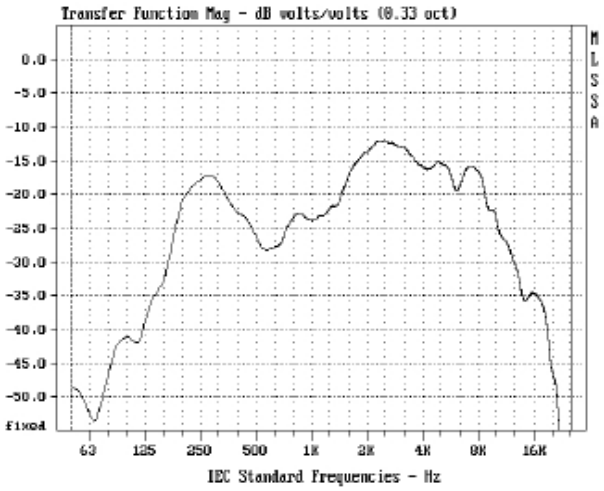
a. The annunciator shall communicate to the fire alarm control panel via an EIA 485 (multi-drop) two-wire communications loop. The system shall support two 6,000 ft. EIA-485 wire runs. Up to 32 annunciators, each configured up to 96 points, may be connected to the connection, for a system capacity of 3,072 points of annunciation.
b. An EIA-485 repeater shall be available to extend the EIA-485 wire distance in 3,000 ft. increments. . The repeater shall be UL864 approved.
c. Each annunciator shall provide up to 96 alarm and 97 trouble indications using a long-life programmable color LED's. Up to 96 control switches shall also be available for the control of Fire Alarm Control Panel functions. The annunciator will also have an "ON-LINE" LED, local piezo sounder, local acknowledge and lamp test switch, and custom zone/function identification labels.
d. The annunciator may be field configured to operate as a "Fan Control Annunciator". When configured as "Fan Control," the annunciator may be used to manually control fan or damper operation and can be set to override automatic commands to all fans/dampers programmed to the annunciator.

e. Annunciator switches may be programmed for System control such as, Global Acknowledge, Global Signal Silence, Global System Reset, and on/off control of any control point in the system.
f. An optional module shall be available to utilize annunciator points to drive EIA-485 driven relays. This shall extend the system point capacity by 3,072 remote contacts.
g. The LED annunciator shall offer an interface to a graphic style annunciator and provide each of the features listed above.

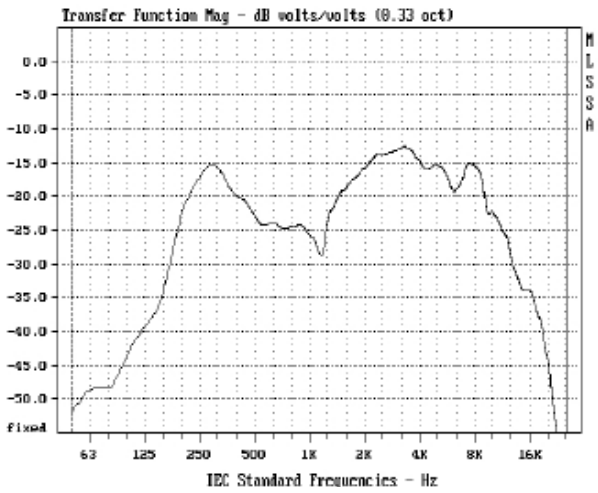
16. SpectrAlert Advance Speakers

a. The Speaker appliance shall be System Sensor SpectrAlert Advance model Speaker. The speaker shall be listed to UL 1480 for Fire Protective Signaling Systems. It shall be a dual-voltage transformer speaker capable of operation at 25.0 or 70.7 nominal Vrms. The speaker shall have a frequency range of 400 to 4,000 Hz and shall have an operating temperature between 32°F and 120°F. It shall mount to a 4 x 4 x 2 1/8-inch back box.
b. A universal mounting plate shall be used for mounting ceiling and wall speaker products. The notification appliance circuit and amplifier wiring shall terminate at the universal mounting plate.
c. Speakers shall be plug-in and shall have the ability to check wiring continuity via a shorting spring on the universal mounting plate. The shorting spring shall also provide tamper resistance via an open circuit if the device is removed. Speaker design shall isolate speaker components to reduce ground fault incidents.
d. The speaker shall have power taps (from ¼ watt to 2 watts) and voltage that are selected by rotary switches. All models shall have a maximum sound output of 86 dB at 10 feet and shall incorporate an open back construction.
e. All notification appliances shall be backward compatible.

Ceiling Speaker
Wide Band Frequency Response



Wall Speaker
Wide Band Frequency Response



Note: The wide band frequency response is derived using MLS methods

17. SpectrAlert Advance Speaker Strobes

    a. The Speaker Strobe appliance shall be System Sensor SpectrAlert Advance model Speaker Strobe. The speaker strobe shall be listed to UL 1971 and UL 1480 and be approved for fire protective signaling systems. It shall be a dual-voltage transformer speaker strobe capable of operation at 25.0 or 70.7 nominal Vrms. The speaker shall have a frequency range of 400 to 4,000 Hz and shall have an operating temperature between 32°F and 120°F. It shall mount to a 4 x 4 x 2 1/8-inch back box.

    b. A universal mounting plate shall be used for mounting ceiling and wall speaker strobe products. The notification appliance circuit and amplifier wiring shall terminate at the universal mounting plate. Also, SpectrAlert Advance speaker strobes and the Sync•Circuit™ Module MDL3 accessory, if used, shall be powered from a non-coded notification appliance circuit output and shall operate on a nominal 12 or 24 volts (includes fire alarm panels with built in sync). When used with the Sync•Circuit Module MDL3, 12-volt rated notification appliance circuit outputs shall operate between 8.5 and 17.5 volts; 24-volt rated notification appliance circuit outputs shall operate between 16.5 to 33 volts. If the notification appliances are not UL 9th edition listed with the corresponding panel or power supply being used, then refer to the compatibility listing of the panel to determine maximum devices on a circuit.

    c. Speaker strobes shall be plug-in and shall have the ability to check wiring continuity via a shorting spring on the universal mounting plate. The shorting spring shall also provide tamper resistance via

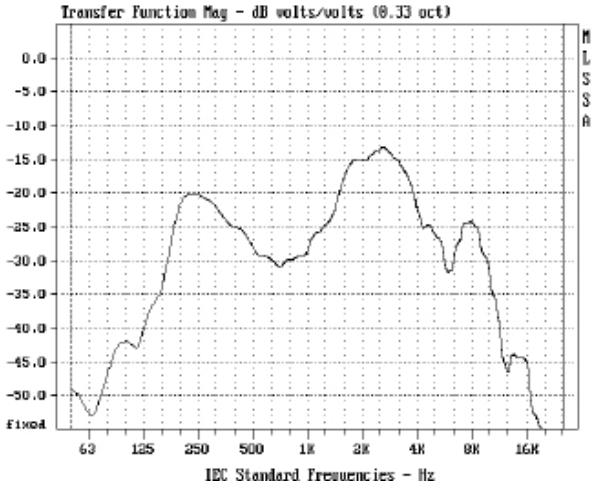
an open circuit if the device is removed. Speaker strobe design shall isolate speaker components to reduce ground fault incidents.

d. The speaker strobe shall have power taps (from ¼ watt to 2 watts) and voltage that are selected by rotary switches. All models shall have a maximum sound output of 86 dB at 10 feet and shall incorporate an open back construction. The strobe shall consist of a xenon flash tube with associated lens/reflector system and operate on either 12V or 24V. The strobe shall also feature selectable candela output, providing options for 15 or 15/75 candela when operating on 12V and 15, 15/75, 30, 75, 110, or 115 when operating on 24V. The strobe shall comply with NFPA 72 and the Americans with Disabilities Act requirement for visible signaling appliances, flashing at 1 Hz over the strobe's entire operating voltage range.

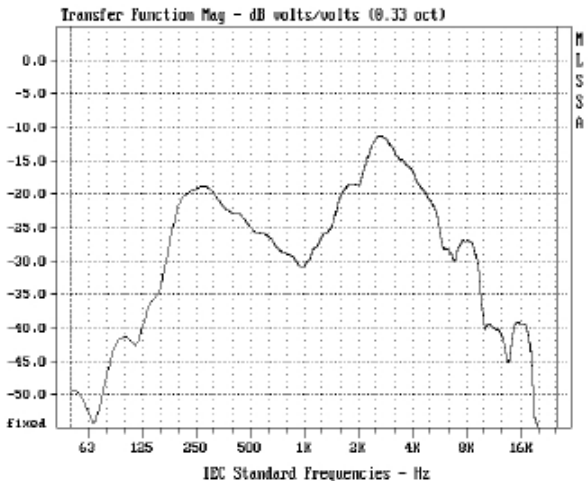
e. All notification appliances shall be backward compatible.

f. Strobe lights shall meet the requirements of the ADA, UL Standard 1971and be fully synchronized.

Ceiling Speaker Strobe
Wide Band Frequency Response



Wall Speaker Strobe
Wide Band Frequency Response



Note: The wide band frequency response is derived using MLS methods

F. Installation

1. Installation shall be in accordance with the NEC, NFPA 72, local and state codes, as shown on the drawings, and as recommended by the major equipment manufacturer.
2. All conduit, junction boxes, conduit supports and hangers shall be concealed in finished areas and may be exposed in unfinished areas. Smoke detectors shall not be installed prior to the system programming and test period. If construction is ongoing during this period, measures

shall be taken to protect smoke detectors from contamination and physical damage.

3. All fire detection and alarm system devices, control panels and remote annunciators shall be flush mounted when located in finished areas and may be surface mounted when located in unfinished areas.
4. Manual fire alarm boxes shall be suitable for surface mounting or semi-flush mounting as shown on the plans, and shall be installed not less than 42 inches (1067 mm), nor more than 48 inches (122 mm) above the finished floor.

G. Test

The service of a competent, factory-trained engineer or technician authorized by the manufacturer of the fire alarm equipment shall be provided to technically supervise and participate during all of the adjustments and tests for the system. All testing shall be in accordance with NFPA 72.

1. Before energizing the cables and wires, check for correct connections and test for short circuits, ground faults, continuity, and insulation.
2. Close each sprinkler system flow valve and verify proper supervisory alarm at the FACP.
3. Verify activation of all waterflow switches.
4. Open initiating device circuits and verify that the trouble signal actuates.
5. Open and short signaling line circuits and verify that the trouble signal actuates.
6. Open and short notification appliance circuits and verify that trouble signal actuates.
7. Ground all circuits and verify response of trouble signals.
8. Check presence and audibility of tone at all alarm notification devices.
9. Check installation, supervision, and operation of all intelligent smoke detectors using the walk test.
10. Each of the alarm conditions that the system is required to detect should be introduced on the system. Verify the proper receipt and the proper processing of the signal at the FACP and the correct activation of the control points.
11. When the system is equipped with optional features, the manufacturer's manual shall be consulted to determine the proper testing procedures. This is intended to address such items as verifying controls performed by individually addressed or grouped devices, sensitivity monitoring, verification functionality and similar.

H. Final Inspection

1. At the final inspection, a factory-trained representative of the manufacturer of the major equipment shall demonstrate that the system functions properly in every respect.

I. Instruction

1. Instruction shall be provided as required for operating the system. Hands-on demonstrations of the operation of all system components and the entire system including program changes and functions shall be provided.
2. The contractor and/or the systems manufacturer's representatives shall provide a typewritten "Sequence of Operation."

PART 3 - EXECUTION

3.01 WORK COORDINATION AND JOB OPERATIONS:

A. Equipment shall not be installed in congested and possible problem areas without first coordinating installation of same with other trades. Relocate electrical equipment installed in congested or problem areas should it interfere with the proper installation of equipment to be installed by other trades.

B. Particular attention shall be directed to coordination of lighting fixtures and other electrically operated equipment requiring access which is to be installed in ceiling areas. Coordinate with other trades, the elevations of equipment in hung ceiling areas to insure adequate space for installation of recessed fixtures before said equipment is installed. Conflicts in mounting heights and clearances above hung ceilings for installation of recessed lighting fixtures or other electrically operated equipment requiring access shall be brought to the attention of Architect for a decision prior to equipment installation.

C. Furnish to General Contractor and other subcontractors information relative to portions of electrical installation that will affect other trades sufficiently in advance so that they may plan their work and installation.

D. Obtain from other trades information relative to electrical work which he, the Electrical Subcontractor, is to execute in conjunction with installation of other trades' equipment.

E. Lighting fixtures in mechanical spaces or utility/ storage rooms shall only be installed after all mechanical equipment is in place.

3.02 PLANS AND SPECIFICATIONS:

A. Plans:

1. Drawings showing layout of electrical systems indicate approximate location of raceways, outlets and apparatus. Runs of feeders and branch circuits are schematic and are not intended to show exact routing. Final determination as to routing shall be governed by structural conditions and other obstructions.

B. Specifications:

a. Specifications supplement drawings and provide specifics pertaining to methods and material to be used.

3.03 IDENTIFICATION:

A. Equipment shall be marked for ease of identification as follows.

1. Provide screw on nameplates on panel boards, F.A. terminal cabinets, starters, and disconnect switches. Nameplates to be of black phenolic with white engraving. For starters and disconnect switches lettering shall be minimum of 1/4" high. Nameplates on panel boards shall have the following information.
   a. Line 1 - Panel designation in 1/2" high letters.
   b. Line 2 - Utilization voltage in 3/8" high letters.
   c. Line 3 - Distribution source "Fed from ____" in 1/4" high letters.
   d. Provide screw on nameplate for available fault current of the electrical service in accordance to NEC 110-24. Provide the voltage, available short circuit current along with the date of the installation.
   e. Neatly typed directory cards listing circuit designations shall be fastened inside the cover of panel boards. Spare circuits shall be penciled.
   f. Color coding schedules. If there is more than a single system voltage, different voltages shall have secondary switchboard and distribution panel and shall be of the phenolic nameplate type as previously specified. A typewritten color code schedule shall also be affixed, under plastic, inside each panel board door.
   g. Outlet boxes both concealed and exposed shall be identified as to panel origination and circuit number by means of fibre pen on the inside of cover plate.
   h. Special system outlet boxes concealed above hung ceilings shall be identified as to system by spray painting during roughing. The following systems shall be identified.
      1) Fire Alarm - red.
      2) Normal/Emergency - yellow.
      3) Security - blue.
      4) Sound - green
   i. Wiring device plates on devices connected to normal emergency circuits shall be red in color.
   j. All conductors in boxes larger than standard outlet boxes, in all wireways, trench headers, etc. shall be grouped logically and be identified.
   k. Grounding conductors and neutrals shall be labeled in panels, wireways, etc. as to circuits associated with.

3.04 PROTECTION AND CLEANUP:

A. Protection:

1. Materials and equipment shall be suitably stored and protected from weather.
   a. During progress of work, pipe and equipment openings shall be temporarily closed so as to prevent obstruction and damage.
   b. Be responsible for maintenance and protection of material and equipment until final acceptance.

B. Cleanup:

1. Keep job site free from accumulation of waste material and rubbish. Remove all rubbish, construction equipment, and surplus materials from site and leave premises in a clean condition.
   a. At completion, equipment with factory finished surfaces shall be cleaned and damaged spots touched up with the same type paint applied at factory.
   b. Particular attention is called to Section 110 12(c) of the NEC, which requires that internal parts of electrical equipment not be contaminated by construction operations.

3.05 PORTABLE OR DETACHABLE PARTS:

A. Retain possession of and be responsible for spare parts, portable and detachable parts, and other removable portions of installation including fuses, keys, locks, blocking clips, inserts, lamps, instructions, drawings, and other devices or materials that are relative to and necessary for proper operation and maintenance of the system until final acceptance, at which time such parts shall be installed or turned over to the Owner, as the case may be.

3.06 SAFETY PRECAUTIONS:

A. Provide proper guards, signage, and other necessary construction required for prevention of accidents and to insure safety of life and property. Remove any temporary safety precautions at completion.

3.07 MOUNTING HEIGHTS:

A. All electrical equipment shall be mounted at the following heights unless noted or detailed otherwise on drawings. Notes on architectural drawings shall supersede those noted below or detailed on the electrical drawings. If mounting height of an electrical component is questionable, obtain clarification from Architect before installation.

1. Duplex convenience outlets, microphone outlets, and telephone outlets - 18 inches.
    a. Light switches, pushbutton stations, HOA switches, and all other toggle or control switches for the operation of heating, ventilating, and air conditioning, plumbing, and general service - 48 inches.
    b. Fire alarm pullstations - 48 inches.
    c. Fire alarm audio visual signals - 80 inches or 6 inches below ceiling, whichever is lower.
    d. Panelboards for lighting, power, telephone, and other auxiliary systems - 78" to top.
    e. Equipment located in lobbies shall be located as detailed on architectural drawings or as directed by Architect.
    f. All receptacles, light switches, fire alarm signals, and clocks sharing a common location shall be symmetrically arranged.
    g. Exterior and interior wall brackets shall be as detailed on architectural drawings or as directed by Architect.

B. Mounting heights given are from finished floor to centerline. In the case of a raised floor, surface of raised floor is the finished floor.

3.08 WORKMANSHIP AND INSTALLATION METHODS:

A. Work shall be installed in first class manner consistent with best current trade practices. Equipment shall be securely installed plumb and/or level. Flush mounted outlet boxes shall have front edge flush with finished wall surface. No electrical equipment shall be supported by work of other trades. Cable systems shall be supported and not draped over ducts and piping or laid on ceiling suspension members. Lighting fixtures shall be installed to agree with Architects reflected ceiling plans.

B. Supports

1. Support work in accordance with best industry practice and by use of standard fittings.
2. In general, walls and partitions will not be suitable for supporting weight of panelboards, dry type transformers and the like. Provide supporting frames or racks extending from floor slab to structure above.
3. Provide supporting frames or racks for equipment, intended for vertical surface mounting in free standing position where no walls exist.
4. Supporting frames or racks shall be of standard angle, standard channel or specialty support system steel members, rigidly bolted or welded together and adequately braced to form a substantial structure. Racks shall be of ample size to assure a workmanlike arrangement of equipment.

5. Provide 3/4" thick painted plywood mounting surfaces in all electric and telephone areas and for all equipment on free standing racks. All plywood shall be fire retardant and painted both sides and edges with 2 coats of white paint.
6. No work for exposed installations in damp locations shall be mounted directly on any building surface. In such locations, flat bar members or spacers shall be used to create a minimum of 1/4" air space between building surfaces and work.
7. Nothing (including outlet, pull and junction boxes and fittings) shall depend on electric raceways or cables for support. All outlet, pull, and junction boxes shall be independently supported.
8. Nothing shall rest on, or depend for support on, suspended ceiling or its mounting members.
9. Support surface or pendant mounted lighting fixtures:
10. From outlet box by means of an interposed metal strap, where weight is less than five pounds.
11. From outlet box by means of a hickey or other direct threaded connection, where weight is from five to fifty pounds.
12. Directly from structural slab, deck or framing member, where weight exceeds fifty pounds.
13. Pendant lighting fixtures shall be supported by threaded rods in non public areas and by manufacturers standard tube hangers with swivel aligner and canopy in public areas. Provide nonstandard pendant lengths where required to mount fixtures at elevations either called for on drawings or as shown in architectural elevations.
14. Support recessed lighting fixtures directly from structural slabs, decks or framing members, by means of jack chain or air craft cable, one at each end of fixture at opposite corners.
15. Where support members must of necessity penetrate air ducts, provide airtight sealing provisions which allow for a relative movement between the support members and the duct walls.
16. Provide channel sills or skids for leveling and support of all floor mounted electrical equipment.
17. Where permitted loading is exceeded by direct application of electrical equipment to a slab or deck, provide proper dunnage as required to distribute the weight in a safe manner.
18. Support metallic raceways by either running within steel frame or hung from the building frame. Anything hung from building frame shall be attached with metallic fasteners.

C. Fastenings

1. Fasten electric work to building structure in accordance with the best industry practice.
    a. Where weight applied to attachment points is 100 pounds or less, fasten to building elements of:

b. Wood - with wood screws.
c. Concrete and solid masonry - with bolts and expansion shields.
d. Hollow construction - with toggle bolts.
e. Solid metal - with machine screws in tapped holes or with welded studs.
f. -Where weight applied to attachment points exceeds 100 pounds, fasten as follows:
g. At field poured concrete slabs, provide inserts with 18" minimum length slip through steel rods, set transverse to reinforcing steel.
h. Where building is steel framed, utilize suitable auxiliary channel or angle iron bridging between structural steel elements to establish fastening points. Bridging members shall be suitably welded or clamped to building steel. Provide threaded rods or bolts to attach to bridging members.
i. Floor mounted equipment shall not be held in place solely by its own dead weight. Provide floor anchor fastenings. Floor mounted equipment over 72 inches in height shall also be braced to nearest wall or overhead structural elements.
j. For items which are shown as being mounted at locations where fastenings to the building construction element above is not possible, provide suitable auxiliary channel or angle iron bridging to building structural elements.
k. Fastenings for metallic raceways using the fastening as support shall be of the metallic type. Fastenings to hold raceways or cables in place may be via tie wraps.

D. General Raceway Installation:

1. Install the various types of raceways in permitted locations as previously specified. All raceways shall be run concealed. Consult Architect for instruction for raceways which must be exposed in public spaces.
   a. Raceways for normal emergency or emergency only wiring cannot contain other conductors.
   b. Raceways shall be properly aligned, grouped, and supported in accordance with code. Exposed raceways shall be installed at right angles to or parallel with structural members. Concealed raceways may take most direct route between outlets.
   c. Raceways run on trapeze hangers shall be secured to the trapeze.
   d. Raceways shall be continuous and shall enter and be secured to all boxes in such a manner that each system shall be electrically continuous from service to all outlets. Provide grounding bushings and bonding jumpers where raceways attach to painted enclosures or terminate below equipment.
   e. Where raceways enter boxes, cabinets, tap boxes, other than those having threaded hubs, a standard locknut shall be used on the outside and locknut and bushing on the inside.

f. Where raceways terminate below equipment and there is no direct metal-to-metal continuity, provide grounding bushings on raceways and interconnect with equipment grounding conductor.
g. All empty raceways shall be provided with a pull wire.
h. All raceway sleeves, stub ups, or stub outs, where not connected to a box or cabinet, shall be terminated with a bushing.
i. All raceway joints shall be made up tight and no running threads will be permitted.
j. Where raceways are cut, the inside edge shall be reamed smooth to prevent injury to conductors.
k. All vertical raceways passing through floor slabs shall be supported.
l. Raceways shall not be installed in concrete slabs above grade or below waterproofed slabs.
m. Electric raceways and/or sleeves passing through floors or walls shall be of such size and in such location as not to impair strength of construction. Where raceways alter structural strength or the installation is questionable, the structural engineer shall be contacted for approval.
n. Raceways shall not run directly above or below heat producing apparatus such as boilers, nor shall raceways run parallel within 6 inches of heated pipes. Raceways crossing heated pipes shall maintain at least a 1 inch space from them.
o. Raceways shall be installed in such a manner as to prevent collection of trapped condensates, and all runs shall be arranged to drain.
p. Raceways passing between refrigerated and non refrigerated spaces and those penetrating enclosures with air movement shall be provided with seals.
q. Raceways feeding fire and jockey pumps shall be rigid metal conduit either run below slab or inside 2 hour rated enclosure. Final connections to motors shall be liquidtite flexible conduit.
r. Where two alternate wiring methods interconnect such as EMT to flexible metal conduit, an outlet box shall be provided.
s. All empty raceways entering building and all sleeves or core drilled openings through floors shall be sealed.
t. Each exterior raceway or assembly in a ductbank shall be provided with continuous warning tape installed 12 inches above raceway or ductbank.
u. Underground rigid non-metallic raceways where allowed and run as a ductbank encased in concrete shall be installed with plastic spacers to ensure a separation of 3 inches between raceways. Top of ductbanks shall be 30 inches below grade, unless otherwise detailed.
v. Elbows and extensions of rigid non-metallic raceway systems which penetrate slabs shall be rigid or intermediate metal conduit.

w. Raceways used for transformer connections shall be flexible type and shall contain a grounding conductor.
x. Raceways entering building through foundation wall into a basement area shall be provided with wall entrance seals or with other acceptable waterproofing method.

E. General Outlet Box Installation:

1. Boxes shall be set flush with finish surface and provided with proper type extension rings or plaster covers. Through-the-wall boxes are not permitted. Check device or fixture to be mounted to box to ensure box orientation is proper.
   a. In addition to boxes shown, install additional boxes where needed to prevent damage to cables and wires during pulling-in operation.
   b. Remove knockouts only as required and plug unused openings.
   c. Where required for horizontal and vertical alignment of boxes in stud partitions, bar hangers spanning two studs shall be used. Device boxes for insertion type receptacles shall be provided with far side box supports where there are less than two entering nonflexible raceways, and where bar rangers are not provided.
   d. Boxes flush mounted in fire rated partitions and on opposite sides of the partition shall be separated by a distance of 24 inches in accordance with UL listing for the box.
   e. Locations of outlets indicated on drawings are approximate. For items exposed to view, refer to architectural drawings and coordinate locations with masonry joints, panel joints, ceiling grids, structural members, etc.
   f. In case of conflict with standard mounting heights and device alignment, consult Architect prior to roughing.
   g. Check all door swings on architectural drawings to ensure lighting switches are installed on strike side of door.
   h. The right to make any reasonable change in location of outlets prior to roughing is reserved by Architect. "Reasonable change" shall be interpreted as movement within 10 feet of location shown.
   i. Obtain dimensioned plan from Architect for floor outlets.
   j. Outlet boxes for use where surface metal raceways are allowed shall be of a type specifically designed to be used with such surface metal raceway systems.

F. Conductor Installation:

1. No conductors shall be pulled into individual raceways until such raceway system is complete and free of debris. No harmful lubricants shall be used to ease pulling.

a. All conductors shall be wired so that grounded conductor is unbroken; switches in all cases being connected in ungrounded conductor.
b. Connections throughout the entire job shall be made with solderless type devices of approved design satisfactory to Inspector of Wires.
c. All taps and splices shall be insulated equal to that of conductor insulation.
d. All conductors of each feeder in pull boxes etc. shall be grouped, tied together, supported, and identified.
e. All conductors in panelboards and other wiring enclosures shall be neatly formed and grouped.
f. All conductors of emergency only and/or normal/emergency shall be run in separate raceway systems to final outlet box.
g. Provide support for conductors in vertical raceways in accordance with Article 300 19.
h. Strip insulation from conductors with approved tools and only of sufficient length for proper termination. Cutting of conductor stranding is unacceptable.
i. Taps from paralleled conductors shall be of a type which tap each conductor, such as ILSCO "PTA" series.
j. Grounding conductors are to be identified as to associated power circuits.

G. Type MC Cable Installation:

1. Where cable is permitted under the products section, the installation of same shall be done in accordance with code and the following:
   a. Cable shall be supported in accordance with code. Tie wire is not an acceptable means of support. Horizontally run cable supports such as Caddy WMX 6, and clamps on vertical runs such as Caddy CJ6 shall be used. Where cables are supported by the structure and only need securing in place, then tie raps will also be acceptable. Ty raps are not acceptable as a means of support. All fittings, hangers, and clamps for support and termination of cables shall be of types specifically designed for use with cable, i.e., romex connectors not acceptable.
   b. Armor of cable shall be removed with rotary cutter device equal to roto split by Seatek Co., not with hacksaw.
   c. Use split "insuliner" sleeves at terminations.
   d. Any cable system used in conjunction with isolated ground circuits shall have both an isolated ground conductor and an equipment ground conductor.

H. Stranded Conductor Installation:

1. If Contractor selects stranded conductors for # 10 AWG and smaller, terminate such conductors as follows:
   a. No stranded conductor may be terminated under a screw head. Provide insulated terminal lugs for all screw connections equal to Thomas & Betts "STA KON" type RC with forked tongue and turned up toes. Installation of lugs shall be done with compression tool such as T&B WT 145C which prevents opening of tool until full compression action is completed.
   b. Backwired wiring devices shall be of clamp type; screw tightened. Force fit connections not allowed.
   c. Stranded conductors will not be allowed for fire alarm work.

I. Accessibility:

1. Electrical equipment requiring service or manual operation shall be accessible.
   a. Work switches for equipment within accessible hung ceiling spaces, such as fan powered terminal boxes, shall be located at terminal box, and so located so as to be accessible.

J. Vibration Elimination:

1. All equipment connections to rotating equipment or equipment capable of vibration shall be made up by flexible raceways.

K. Wiring Device Gaskets:

1. Provide wiring device gaskets at coverplates where device is mounted in wall separating conditioned and non-conditioned spaces.

3.09 FEEDER CIRCUITS:

A. Provide feeders as called for on the drawings.

B. Feeders shall be defined as any circuit originating from the main building switchboard and/or distribution panels.

3.10 BRANCH CIRCUITS:

A. Provide all branch circuit wiring and outlets for a complete and operating system. The system shall consist of insulated conductors connected to the panelboards and run in raceways or as cable systems if permitted under products section, as required to the final outlet and shall include outlet boxes, supports, fittings, receptacles, plates, fuses, etc.

B. Physical arrangement of branch circuit wiring shall correspond to circuit numbering on drawings. Combining of circuits and raceways will be allowed up to a 3 phase, 4 wire circuit in a single raceway, unless shared neutrals are not allowed by other sections of this Division, or are indicated as separate neutrals on the drawings. Any combination of homeruns such as this, however, shall be indicated on record drawings. Combining of conductors and raceways for tenant fitup work is allowed only for fitup boxes in accordance with details on drawings. When a common grounded conductor is used for more than one circuit, the arrangement shall be such that a receptacle, fixture, or other device may be removed or disconnected without disconnecting the grounded conductor for other circuits. Ground fault circuit breakers and isolated ground outlets shall be wired with separate neutrals and separate grounding conductors per circuit. A consistent phase orientation shall be adhered to throughout project at terminations.

C. Circuits feeding three-phase equipment shall not be combined into common raceways, unless specifically indicated.

D. All wiring in panelboards and cabinets shall be neatly formed and grouped.

3.11 FIREPROOFING AND WATERPROOFING:

A. Examination

1. Before beginning installation, verify that substrate conditions previously installed under other sections are acceptable for installation of firestopping in accordance with manufacturer’s installation instructions and technical information.
2. Surfaces shall be free of dirt, grease, oil, scale, laitance, rust, release agents, water repellants, and any other substances that may inhibit optimum adhesion.
3. Provide masking and temporary covering to protect adjacent surfaces.
4. Do not proceed until unsatisfactory conditions have been corrected.

B. Installation

1. General: Install through-penetration firestop systems in accordance with Performance Criteria and in accordance with the conditions of testing and classification as specified in the published design.
2. Manufacturer’s Instructions: Comply with manufacturer’s instructions for installation of firestopping products.

C. Field Quality Control

1. Inspections: Owner shall engage qualified independent inspection agency to inspect through-penetration firestop systems.

2. Keep areas of work accessible until inspection by authorities having jurisdiction.
3. Where deficiencies are found, repair firestopping products so they comply with requirements.

D. Adjusting and Cleaning

1. Remove equipment, materials, and debris, leaving area in undamaged, clean condition.
2. Clean all surfaces adjacent to sealed openings to be free of excess firestopping materials and soiling as work progresses.

E. Schedules:

	Concrete Floor	**Concrete Wall**	**Gypsum Board Wall**
Penetrant Type			
Blank Opening	C-AJ-0100, C-AJ-0101	C-AJ-0100, C-AJ-101	
Metal Conduits	C-AJ-1080, C-AJ-1240, C-AJ-1353	C-AJ-1080, W-J-1098, W-J-1100	W-L-1049, W-L-1222, W-L-1168
Plastic Conduits/ Raceways	C-AJ-2140, C-AJ-2292	W-J-2018, W-J-2076	W-L-2093, W-L-2241
Cables	F-A-3021, F-A-3037	W-J-3098, W-J-3130, W-J-3158, W-J-3180	W-L-3218, W-L-3255, W-L-3306, W-L-3377

3.12 CUTTING AND PATCHING:

A. All cutting of surfaces, including core drilling of walls and slabs, shall be done by Electrical Subcontractor. Openings through new wall surfaces will be provided by General Contractor if Electrical Subcontractor gives suitable notice as erection of surface proceeds. If suitable notice is not given, Electrical Subcontractor shall then be responsible for cost of corrective work required.

B. Patching will be provided by the trade responsible for the surface to be patched.

3.13 MECHANICAL SYSTEM COORDINATION:

A. The Mechanical System Subcontractor will be providing various items of mechanical services equipment and control apparatus. In general, Electrical Subcontractor shall connect up power wiring to this equipment. Equipment provided by Mechanical System Subcontractors will include built in disconnecting means and overcurrent protection unless shown otherwise on drawings.

B. The Mechanical and Electrical Subcontractor shall closely coordinate their respective portions of work.

C. If, due to local regulations, electric heating equipment furnished by the mechanical systems subcontractor is required to be installed by licensed electricians in order to allow connection by Electrical Subcontractor's licensed electricians, it will then be Mechanical Subcontractor's responsibility to engage and pay for services of such licensed electricians.

D. All built in disconnecting means provided by Mechanical Systems Subcontractors of fusible type, shall be complete with fuses. Any fuses provided by Mechanical System Subcontractor shall comply with requirements as specified under electrical section.

E. Power wiring to be provided by Electrical Subcontractor is the line voltage power supply wiring. Control wiring is responsibility of Mechanical System Subcontractor unless specifically indicated on electrical drawings, or in this Division of the specifications. Temperature Control Subcontractor shall refer to electrical drawings for location of all magnetic starters.

F. 120-volt control wiring sources to temperature control panels is the responsibility of Electrical Subcontractor.

3.14 DISTRIBUTION EQUIPMENT TESTING:

A. All distribution panels, motor controls, motor control centers, feeder conductors, and emergency systems shall be tested in accordance with the following. In general, all tests shall be done in accordance with the 1995 Acceptance Testing Specifications of the International Electrical Testing Association.

B. The Testing Subcontractor may be an independent contractor or a manufacturer of the equipment which is to be tested.

C. Test report forms, delineating tests to be made, and method of recording same shall be submitted prior to commencing work. Test reports when submitted shall include interpretation of results and recommendation for any corrective work required.

D. Main Distribution Panels:

1. Visual Inspection:
    a. Check for foreign material within bus enclosure.
    b. Check for missing hardware.
    c. Inspect entire assemblies for transit damage or factory defects.
    d. Check for all bus dimensions and bracing per specifications.
    e. Check ratings of current transformers and potential transformers.

f. Check ratings of all protective relays per drawings.
g. Physical Inspection:
h. Torque all bus hardware to proper tension.
i. Circuit breaker interlocks all work properly.
j. All doors and hinged panels open and close properly.
k. Relay blocking removed from all control and protective relays.
l. All circuit breakers operate, close and trip mechanically.
m. Torque all feeder conductors to terminal manufacturers' recommendations.
n. Electrical Testing:
o. Breakers operated electrically trip and close from local and remote positions.
p. Insulation resistance tests made on all circuit breakers, line to load breaker open, line to ground breaker closed, 3 poses tested individually. Switchgear bus to be tested phase to phase and phase to ground with Megohometer type instrument. Relays also to be insulation resistance tested.

E. Transformers:

1. Visual inspection for transit damage such as broken porcelain, brazed connections broken off, core shifted on frame, winding damage, etc.
   a. Insulation resistance tests in accordance with U.S.A.S.I. Standard C571222 and NEMA TRI-2.055.
   b. D.C. over-potential test procedures and A.C. voltage values for factory proof testing of C57.12968 and NEMA TRI-2.055. The ratio applied for converting A.C. test potential to equivalent D.C. value is 1.6.
   c. Acceptance test voltage for new transformers at D.C. value will be 75% of equivalent A.C. voltage used for factor proof testing the value will be 65%.
   d. Transformers shall be subjected to a ratio and polarity test to prove the polarity and winding ratio as in accordance with nameplate specifications.
   e. Torque all connections to terminal manufacturers' recommendations.
   f. Magnetic Starters:
2. Visual inspection to determine:
   a. Shipping damage.
   b. Proper bussing and contactor sizes.
   c. Correct overload relay heater ratings. Any incorrectly sized overloads shall be replaced by the contractor who originally provided same.
   d. Electrical Testing:
   e. Electrical operation of control relays, timing relay, and contactor coils.

f. Insulation resistance test on all current carrying bus to ground and between phases.
g. Calibration check of overload heater to ascertain tripping point and time delay at 300% of heater rating.

F. Conductors: All secondary service conductors and all feeder conductors from switchboards and distribution panels shall be tested.

1. Visual and mechanical inspection
   a. Conductors to be inspected for physical damage and proper connection and sizing in accordance with single line diagram.
   b. Conductor connections shall be torque tested to manufacturer's recommended values.
   c. Electrical Tests
   d. Perform insulation resistance test on each conductor with respect to ground and adjacent conductor.
   e. Perform continuity test to insure proper conductor connection.

G. Emergency Systems:

1. Engine Generator - Prior to the emergency generator test specified under the emergency generator specification, the testing contractor shall perform the following:
   a. Visual and Mechanical Inspection
      1) Inspect for physical damage.
      2) Compare nameplate rating and connection with specifications and single line diagram.
      3) Inspect for proper anchorage and grounding. Verify engine cooling and fuel system integrity.
   b. Electrical and Mechanical Tests
      4) Perform a dielectric absorption test on generator winding with respect to ground. Determine polarization index.
      5) Perform phase rotation test to determine compatibility with load requirements.
      6) Test protective relay devices in accordance with applicable sections of these specifications.
      7) Perform dc over-potential test between winding and ground.
   c. Automatic Transfer Switches
   d. Visual and Mechanical Inspection
      1) Inspect for physical damage.
      2) Verify that the short circuit withstand rating exceeds the available short circuit duty.
      3) Compare equipment nameplate information and connections with single line diagram and report any discrepancies.
      4) Check switch to ensure positive interlock between normal and alternate sources. (Mechanical and electrical).

5) Check tightness of all control and power connections.
6) Perform manual transfer operation.
7) Ensure manual transfer warnings are attached and visible to operator.

e. Electrical Tests.
1) Perform insulation resistance tests phase to phase and phase to ground with switch in both source positions.
2) Measure contact resistance in normal and alternate source position.
3) Set and calibrate in accordance with the project electrical engineer's specifications.
- Voltage and frequency sensing relays.
- All time delay relays.
- Engine start and shutdown relay.
4) Perform automatic transfer by tests.
- Simulating loss of normal power.
- Return to normal power.
- Simulating loss of emergency power on return to normal.
- Simulate all forms of single phase conditions.
5) Monitor and verify correct operation and timing.
- Normal voltage sensing relays.
- Engine start sequence.
- Time delay upon transfer.
- Alternate voltage sensing relays.
- Automatic transfer operation.
- Interlocks and limit switch function.
- Timing delay and retransfer upon normal power restoration.
- Engine cooldown and shutdown feature.

H. Grounding Grids or Electrodes: Measurement of resistance from ground grids or electrodes to earth to determine adequacy of grounding system in building and compliance with specifications and/or electrical code.

I. Settings of Adjustable Devices: Using the result of the fault current and coordination study specified hereinafter, the Testing Contractor shall set all adjustable devices.

3.15 FAULT CURRENT/COORDINATION STUDY/ARC FLASH ANALYSIS:

A. Employ the manufacturer of the secondary distribution equipment or an independent organization to perform a fault current and coordination study to

ensure a selectively coordinated system from the incoming mains to the branch circuit panelboards.

B. The report shall be submitted in a standard format and shall include the fault current availability at various points in the distribution system, breaker coordination curves, and recommended settings of all adjustable devices in the system.

C. Scope

1. The contractor shall furnish short-circuit and protective device coordination studies as prepared by the electrical equipment manufacturer or an approved engineering firm.
   a. The contractor shall furnish an Arc Flash Hazard Analysis Study per the requirements set forth in NFPA 70E-Standard for Electrical Safety in the Workplace. The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in NFPA70E-2004, Annex D.

D. References

1. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
   a. IEEE 141 – Recommended Practice for Electric Power Distribution and Coordination of Industrial and Commercial Power Systems.
   b. IEEE 242 – Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems.
   c. IEEE 399 – Recommended Practice for Industrial and Commercial Power System Analysis.
   d. IEEE 241 – Recommended Practice for Electric Power Systems in Commercial Buildings.
   e. IEEE 1015 – Recommended Practice for Applying Low-Voltage Circuit Breakers Used in Industrial and Commercial Power Systems.
   f. IEEE 1584 - Guide for Performing Arc-Flash Hazard Calculations.
   g. American National Standards Institute (ANSI):
   h. ANSI C57.12.00 – Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers.
   i. ANSI C37.13 – Standard for Low Voltage AC Power Circuit Breakers Used in Enclosures.
   j. ANSI C37.010 – Standard Application Guide for AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis.
   k. ANSI C 37.41 – Standard Design Tests for High Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches and Accessories.
   l. The National Fire Protection Association (NFPA):

m. NFPA 70 - National Electrical Code, latest edition.
n. NFPA 70E – Standard for Electrical Safety in the Workplace.

E. Submittals for Review Approval

1. The short-circuit and protective device coordination studies shall be submitted to the design engineer prior to receiving final approval of the distribution equipment shop drawings and/or prior to release of equipment drawings for manufacturing. If formal completion of the studies may cause delay in equipment manufacturing, approval from the engineer may be obtained for preliminary submittal of sufficient study data to ensure that the selection of device and characteristics will be satisfactory.

F. Submittals for Construction

1. The results of the short-circuit, protective device coordination and arc flash hazard analysis studies shall be summarized in a final report. No more than five (5) bound copies of the complete final report shall be submitted. For large system studies, submittals requiring more than five (5) copies of the report will be provided without the section containing the computer printout of the short-circuit input and output data. Additional copies of the short-circuit input and output data, where required, shall be provided on CD in PDF format.
   a. The report shall include the following sections:
   b. Executive Summary.
   c. Descriptions, purpose, basis and scope of the study.
   d. Tabulations of circuit breaker, fuse and other protective device ratings versus calculated short circuit duties.
   e. Protective device time versus current coordination curves, tabulations of relay and circuit breaker trip unit settings, fuse selection.
   f. Fault current calculations including a definition of terms and guide for interpretation of the computer printout.
   g. Details of the incident energy and flash protection boundary calculations.
   h. Recommendations for system improvements, where needed.
   i. One-line diagram.
   j. Arc flash labels shall be provided in hard copy only

G. Qualifications

1. The short-circuit, protective device coordination and arc flash hazard analysis studies shall be conducted under the supervision and approval of a Registered Professional Electrical Engineer skilled in performing and interpreting the power system studies

a. The Registered Professional Electrical Engineer shall be a full-time employee of the equipment manufacturer or an approved engineering firm
b. The Registered Professional Electrical Engineer shall have a minimum of five (5) years of experience in performing power system studies
c. The equipment manufacturer or approved engineering firm shall demonstrate experience with Arc Flash Hazard Analysis by submitting names of at least ten actual arc flash hazard analysis it has performed in the past year

H. Computer Analysis Software

1. The studies shall be performed using the latest revision of the SKM Systems Analysis Power*Tools for Windows (PTW) software program

I. Studies

1. Contractor to furnish short-circuit and protective device coordination studies as prepared by equipment manufacturer or an approved engineering firm.
   a. The contractor shall furnish an Arc Flash Hazard Analysis Study per NFPA 70E - Standard for Electrical Safety in the Workplace, reference Article 130.3 and Annex D.

J. Data Collection

1. Contractor shall furnish all data as required by the power system studies. The Engineer performing the short-circuit, protective device coordination and arc flash hazard analysis studies shall furnish the Contractor with a listing of required data immediately after award of the contract. The Contractor shall expedite collection of the data to assure completion of the studies as required for final approval of the distribution equipment shop drawings and/or prior to the release of the equipment for manufacturing.
   a. Source combination may include present and future motors and generators.
   b. Load data utilized may include existing and proposed loads obtained from Contract Documents provided by Owner, or Contractor.
   c. If applicable, include fault contribution of existing motors in the study. The Contractor shall obtain required existing equipment data, if necessary, to satisfy the study requirements.

K. Short-Circuit and Protective Device Evaluation Study

1. Use actual conductor impedances if known. If unknown, use typical conductor impedances based on IEEE Standard 141-1993.

a. Transformer design impedances shall be used when test impedances are not available.
b. Provide the following:
c. Calculation methods and assumptions.
d. Selected base per unit quantities.
e. One-line diagram of the system being evaluated.
f. Source impedance data, including electric utility system and motor fault contribution characteristics.
g. Tabulations of calculated quantities.
h. Results, conclusions, and recommendations.
i. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault at each:
j. Electric utility's supply termination point
k. Incoming switchgear
l. Unit substation primary and secondary terminals
m. Low voltage switchgear
n. Motor control centers
o. Standby generators and automatic transfer switches
p. Branch circuit panelboards
q. Other significant locations throughout the system.
r. For grounded systems, provide a bolted line-to-ground fault current study for areas as defined for the three-phase bolted fault short-circuit study.
s. Protective Device Evaluation:
t. Evaluate equipment and protective devices and compare to short circuit ratings
u. Adequacy of switchgear, motor control centers, and panelboard bus bars to withstand short-circuit stresses
v. Notify Owner in writing, of existing, circuit protective devices improperly rated for the calculated available fault current.

L. Protective Device Coordination Study

1. Proposed protective device coordination time-current curves (TCC) shall be displayed on log-log scale graphs.
   a. Include on each TCC graph, a complete title and one-line diagram with legend identifying the specific portion of the system covered.
   b. Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which the device is exposed.
   c. Identify the device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay, and instantaneous settings recommended.
   d. Plot the following characteristics on the TCC graphs, where applicable:
   e. Electric utility's overcurrent protective device

f. Medium voltage equipment overcurrent relays
g. Medium and low voltage fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands
h. Low voltage equipment circuit breaker trip devices, including manufacturer's tolerance bands
i. Transformer full-load current, magnetizing inrush current, and ANSI through-fault protection curves
j. Conductor damage curves
k. Ground fault protective devices, as applicable
l. Pertinent motor starting characteristics and motor damage points, where applicable
m. Pertinent generator short-circuit decrement curve and generator damage point
n. The largest feeder circuit breaker in each motor control center and applicable panelboard.
o. Provide adequate time margins between device characteristics such that selective operation is provided, while providing proper protection.

M. Arc Flash Hazard Analysis

1. The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in NFPA70E-2004, Annex D.
   a. The flash protection boundary and the incident energy shall be calculated at all significant locations in the electrical distribution system (switchboards, switchgear, motor-control centers, panelboards, busway and splitters) where work could be performed on energized parts.
   b. The Arc-Flash Hazard Analysis shall include all significant locations in 240 volt and 208 volt systems fed from transformers equal to or greater than 125 kVA where work could be performed on energized parts.
   c. Safe working distances shall be based upon the calculated arc flash boundary considering an incident energy of 1.2 cal/cm2.
   d. When appropriate, the short circuit calculations and the clearing times of the phase overcurrent devices will be retrieved from the short-circuit and coordination study model. Ground overcurrent relays should not be taken into consideration when determining the clearing time when performing incident energy calculations
   e. The short-circuit calculations and the corresponding incident energy calculations for multiple system scenarios must be compared and the greatest incident energy must be uniquely reported for each equipment location. Calculations must be performed to represent the maximum and minimum contributions of fault current magnitude for all normal and emergency operating conditions. The minimum calculation will assume that the utility

contribution is at a minimum and will assume a minimum motor contribution (all motors off). Conversely, the maximum calculation will assume a maximum contribution from the utility and will assume the maximum amount of motors to be operating. Calculations shall take into consideration the parallel operation of synchronous generators with the electric utility, where applicable.

f. The incident energy calculations must consider the accumulation of energy over time when performing arc flash calculations on buses with multiple sources. Iterative calculations must take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators should be decremented as follows:

g. Fault contribution from induction motors should not be considered beyond 3-5 cycles.

h. Fault contribution from synchronous motors and generators should be decayed to match the actual decrement of each as closely as possible (e.g. contributions from permanent magnet generators will typically decay from 10 per unit to 3 per unit after 10 cycles).

i. For each equipment location with a separately enclosed main device (where there is adequate separation between the line side terminals of the main protective device and the work location), calculations for incident energy and flash protection boundary shall include both the line and load side of the main breaker.

j. When performing incident energy calculations on the line side of a main breaker (as required per above), the line side and load side contributions must be included in the fault calculation.

k. Miscoordination should be checked amongst all devices within the branch containing the immediate protective device upstream of the calculation location and the calculation should utilize the fastest device to compute the incident energy for the corresponding location.

l. Arc Flash calculations shall be based on actual overcurrent protective device clearing time. Maximum clearing time will be capped at 2 seconds based on IEEE 1584-2002 section B.1.2. Where it is not physically possible to move outside of the flash protection boundary in less than 2 seconds during an arc flash event, a maximum clearing time based on the specific location shall be utilized.

N. Report Sections

1. Input data shall include, but not be limited to the following:

a. Feeder input data including feeder type (cable or bus), size, length, number per phase, conduit type (magnetic or non-magnetic) and conductor material (copper or aluminum).

b. Transformer input data, including winding connections, secondary neutral-ground connection, primary and secondary voltage ratings, kVA rating, impedance, % taps and phase shift.
c. Reactor data, including voltage rating, and impedance.
d. Generation contribution data, (synchronous generators and Utility), including short-circuit reactance (X"d), rated MVA, rated voltage, three-phase and single line-ground contribution (for Utility sources) and X/R ratio.
e. Motor contribution data (induction motors and synchronous motors), including short-circuit reactance, rated horsepower or kVA, rated voltage, and X/R ratio.
f. Short-Circuit Output Data shall include, but not be limited to the following reports:
g. Low Voltage Fault Report shall include a section for three-phase and unbalanced fault calculations and shall show the following information for each applicable location:
    1) Voltage
    2) Calculated fault current magnitude and angle
    3) Fault point X/R ratio
    4) Equivalent impedance
h. Momentary Duty Report shall include a section for three-phase and unbalanced fault calculations and shall show the following information for each applicable location:
    1) Voltage
    2) Calculated symmetrical fault current magnitude and angle
    3) Fault point X/R ratio
    4) Calculated asymmetrical fault currents
        a) Based on fault point X/R ratio
        b) Based on calculated symmetrical value multiplied by 1.6
        c) Based on calculated symmetrical value multiplied by 2.7
    5) Equivalent impedance
i. Interrupting Duty Report shall include a section for three-phase and unbalanced fault calculations and shall show the following information for each applicable location:
    1) Voltage.
    2) Calculated symmetrical fault current magnitude and angle.
    3) Fault point X/R ratio.
    4) No AC Decrement (NACD) Ratio.
    5) Equivalent impedance.
    6) Multiplying factors for 2, 3, 5, and 8 cycle circuit breakers rated on a symmetrical basis.
    7) Multiplying factors for 2, 3, 5, and 8 cycle circuit breakers rated on a total basis.
j. Recommended Protective Device Settings:

k. Phase and Ground Relays:
   1) Current transformer ratio.
   2) Current setting.
   3) Time setting.
   4) Instantaneous setting.
   5) Recommendations on improved relaying systems, if applicable.
l. Circuit Breakers:
   1) Adjustable pickups and time delays (long time, short time, ground).
   2) Adjustable time-current characteristic.
   3) Adjustable instantaneous pickup.
   4) Recommendations on improved trip systems, if applicable.
m. Incident energy and flash protection boundary calculations:
n. Arcing fault magnitude.
o. Protective device clearing time.
p. Duration of arc.
q. Arc flash boundary.
r. Working distance.
s. Incident energy.
t. Hazard Risk Category.
u. Recommendations for arc flash energy reduction.

O. Field Adjustment

1. Adjust relay and protective device settings according to the recommended settings table provided by the coordination study.
   a. Make minor modifications to equipment as required to accomplish conformance with short circuit and protective device coordination studies.
   b. Notify Owner in writing of any required major equipment modifications.
   c. Arc Flash Warning Labels
1. The contractor of the Arc Flash Hazard Analysis shall provide a 3.5” by 5” thermal transfer type label of high adhesion polyester for each work location analyzed.
   a. All labels will be based on recommended over-current device settings and will be provided after the results of the analysis have been presented to the owner and after any system changes, upgrades or modifications have been incorporated in the system.
   b. The label shall include the following information, at a minimum:
   c. Location designation.
   d. Nominal voltage.
   e. Flash protection boundary.
   f. Hazard risk category.
   g. Incident energy.
   h. Working distance.

i. Engineering report number, revision number, and issue date.
j. Labels shall be machine printed, with no field markings.
k. Arc flash labels shall be provided in the following manner and all labels shall be based on recommended overcurrent device settings.
l. For each 208 volt panelboard, one arc flash label shall be provided.
m. For each low voltage switchboard, one arc flash label shall be provided.
n. For each switchgear, one flash label shall be provided.

3.16 HORIZONTAL CABLING:

A. The Horizontal Subsystem is the portion of the telecommunications cabling system that extends from the work area telecommunications outlet/connector to the horizontal cross-connect in the telecommunications room.

B. It consists of the telecommunications outlet/connector, the horizontal cables, optional consolidation point, and that portion of the cross-connect in the telecommunications room serving the horizontal cable.

C. Each floor of a building should be served by its own Horizontal Subsystem.

3.17 TELECOMMUNICATIONS ROOM:

A. The Telecommunications Room is generally considered to be a floor serving facility. The Horizontal Cross-connect links the Horizontal Subsystem and the Backbone Subsystem together.

B. The Horizontal Cross-connect shall consist of rack or wall mounted wiring blocks or panels for termination of copper cables or rack or wall mount interconnect centers or fiber management panels/trays for the termination of optical fibers.

C. Cross-connect spaces include the labeling of hardware for providing circuit identification and patch cords or cross-connect wire used for creating circuit connections at the cross-connect.

D. The telecommunications room shall be equipped to contain telecommunications equipment, cable terminations, and associated cross-connects.

E. Separation from sources of EMI shall be in accordance with ANSI/TIA/EIA-569-B and local codes.

F. Communication grounding / earthing and bonding shall be in accordance with applicable codes and regulations. It is recommended that the requirements of IEC/TR3 61000-5-2 - Ed. 1.0, ANSI-J-STD-607-A, or both be observed throughout the entire cabling system.

G. The telecommunications room shall be dedicated to the telecommunications function. Access to telecommunications rooms shall be restricted to authorized service personnel and shall not be shared with building services that may interfere with the telecommunications systems or be used for building maintenance services.

H. Lighting in the telecommunications room should be a minimum of 500 lx (50 foot-candles) at the lowest point of termination. Light switch should be easily accessible when entering the room.

I. A minimum of two dedicated duplex or two dedicated simplex electrical outlet, each on a separate circuit, should be provided for equipment power. Additional convenience duplex outlets should be placed at 1.8 m (6 ft) intervals around the perimeter walls.

3.18 EQUIPMENT ROOM:

A. The Equipment Subsystem consists of shared (common) electronic communications equipment in the equipment room or telecommunications room and the transmission media required to terminate this equipment on distribution

B. The equipment room shall be equipped to contain telecommunications equipment, cable terminations, and associated cross-connects.

C. Separation from sources of EMI shall be as specified in the Telecommunication Room section of this specification.

D. Communication grounding / earthing and bonding shall be in accordance with applicable codes and regulations. It is recommended that the requirements of IEC/TR3 61000-5-2 - Ed. 1.0, ANSI-J-STD-607-A, or both be observed throughout the entire cabling system.

E. The equipment room shall not be shared with building services that may interfere with the telecommunications systems or be used for custodial services.

F. Lighting in the equipment room should be a minimum of 500 lx (50 foot candles) at the lowest point of termination.

G. A minimum of two dedicated duplex or two dedicated simplex electrical outlet each on a separate circuit should be provided for equipment power. Additional convenience duplex outlets should be placed at 1.8 m (6 ft) intervals around the perimeter walls.

3.19 ENTRANCE FACILITY:

A. The entrance facility shall be equipped to contain telecommunications equipment, cable terminations, and associated cross-connects.

B. Separation from sources of EMI shall be as specified ANSI/TIA/EIA-569-B.

C. Communication grounding / earthing and bonding shall be in accordance with applicable codes and regulations. It is recommended that the requirements of IEC/TR3 61000-5-2 - Ed. 1.0, ANSI-J-STD-607-A, or both be observed throughout the entire cabling system.

D. The entrance facility shall not be shared with building services that may interfere with the telecommunications systems or be used for custodial services.

E. The entrance facility shall be located in a dry area not subject to flooding and should be as close as possible to the electrical service room in order to reduce the length of the bonding conductor to electrical grounding system.

F. Lighting in the entrance facility should be a minimum of 500 lx (50 foot-candles) at the lowest point of termination.

G. A minimum of two dedicated duplex or two dedicated simplex electrical outlet each on a separate circuit should be provided for equipment power. Additional convenience duplex outlets should be placed at 1.8 m (6 ft) intervals around the perimeter walls.

3.20 SITE SURVEY:

A. Prior to placing any cable pathways or cable, the contractor shall survey the site to determine job conditions will not impose any obstructions that would interfere with the safe and satisfactory placement of the cables.

B. The arrangements to remove any obstructions with the Project Manager need to be determined at that time.

3.21 CABLE PATHWAYS:

A. Pathways shall be designed and installed to meet applicable local and national building and electrical codes or regulations.

B. Grounding / Earthing and bonding of pathways shall comply with applicable codes and regulations.

C. Pathways shall not have exposed sharp edges that may come into contact with telecommunications cables.

D. The number of cables placed in a pathway shall not exceed manufacture specifications, nor, will the geometric shape of a cable be affected.

E. Pathways shall not be located in elevator shafts.

3.22 HORIZONTAL CABLE ROUTING:

A. All horizontal cables, regardless of media type, shall not exceed 90 m (295 ft) from the telecommunications outlets in the work area to the horizontal cross connect.

B. The combined length of jumpers, or patch cords and equipment cables in the telecommunications room and the work area should not exceed 10m (33 ft) unless used in conjunction with a multi-user telecommunications outlet.

C. Two horizontal cables shall be routed to each work area. At least one horizontal cable connected to an information outlet shall be 4-pair, 100Ω balanced twisted-pair.

D. It is recommended that a minimum horizontal cable distance of 15m (49 ft.) shall be maintained between the telecommunications room and the work area.

E. For installations with consolidation points, a minimum horizontal cable distance of 15m (49 ft.) shall be maintained between the telecommunications room and consolidation point, and 5m (16 ft.) between the consolidation point and the work area.

F. Horizontal pathways shall be installed or selected such that the minimum bend radius of horizontal cables is kept within manufacturer specifications both during and after installation.

G. In open ceiling cabling, cable supports shall be provided by means that is structurally independent of the suspended ceiling, its framework, or supports. These supports shall be spaced no more than 1.5 m (5 ft) apart.

H. UTP ONLY: Telecommunications pathways, spaces and metallic cables, which run parallel with electric power or lighting, which is less than 3kVA, shall be installed with a minimum clearance of 50 mm (2 in).

I. UTP ONLY: Telecommunications pathways, spaces and metallic cables, which run parallel with electric power or lighting, which is more than 3kVA but less than 6kVA, shall be installed with a minimum clearance of 1.5 m (5 ft).

J. UTP ONLY: Telecommunications pathways, spaces and metallic cables, which run parallel with electric power or lighting, which is more than 6kVA, shall be installed with a minimum clearance of 3 m (10 ft).

K. For voice or data applications, 4-pair balanced twisted-pair or fiber optic cables shall be run using a star topology from the telecommunications room serving that floor to every individual information outlet. The customer prior to installation of the cabling shall approve all cable routes.

L. The Contractor shall observe the bending radius and pulling strength requirements of the 4 pair balanced twisted-pair and fiber optic cable during handling and installation.

M. Each run of balanced twisted-pair cable between horizontal portion of the cross-connect in the telecommunication closet and the information outlet shall not contain splices.

N. In a false ceiling environment, a minimum of 75 mm (3 in) shall be observed between the cable supports and the false ceiling.

O. Continuous conduit runs installed by the contractor should not exceed 30.5 m (100 ft) or contain more than two (2) 90-degree bends without utilizing appropriately sized pull boxes.

P. All horizontal pathways shall be designed, installed, and grounded to meet applicable local and national building and electrical codes.

Q. The number of horizontal cables placed in a cable support or pathway shall be limited to a number of cables that will not cause a geometric shape of the cables.

R. Maximum conduit pathway capacity shall not exceed a 40% fill. However, perimeter and furniture fill is limited to 60% fill for move and changes.

S. Horizontal distribution cables shall not be exposed in the work area or other locations with public access.

3.23 WORK AREA TERMINATION:

A. All balanced twisted-pair cables wired to the telecommunications outlet/connector, shall have 4-pairs terminated in eight-position modular outlets in the work area. All pairs shall be terminated.

B. The telecommunications outlet/connector shall be securely mounted at planned locations.

C. The height of the telecommunications faceplates shall be to applicable codes and regulations.

3.24 PULLING TENSION:

A. The maximum cable pulling tensions shall not exceed manufacturer's specifications.

3.25 BEND RADIUS:

A. The maximum cable bend radii shall not exceed manufacturer's specifications.

B. In spaces with balanced twisted-pair cable terminations, the maximum bend radius for 4-pair cable shall not exceed four times the outside diameter of the cable and ten times for multi-pair cable. This shall be done unless this violates manufacturer specifications.

C. During the actual installation, bend radius on 4-pair cable shall not exceed eight times the outside diameter of the cable and ten times for multi-pair cable. This shall be done unless this violates manufacturer specifications.

3.26 SLACK:

A. In the work area, a minimum of 300 mm (12 in) should be left for balanced twisted-pair cables, while 1 m (3 ft) be left for fiber cables.

B. In telecommunications rooms a minimum of 3m (10 ft) of slack should be left for all cable types. This slack must be neatly managed on trays or other support types.

3.27 CABLE TIE WRAPS:

A. Tie wraps shall be used at appropriate intervals to secure cable and to provide strain relief at termination points. These wraps shall not be over tightened to the point of deforming or crimping the cable sheath.

B. Hook and loop cable managers should be used in the closet where reconfiguration of cables and terminations may be frequent.

C. Siemon Company VCM Series Recommended.

3.28 GROUNDING:

A. All grounding / earthing and bonding shall be done to applicable codes and regulations.

3.29 FIRE PROTECTION:

A. Properly installed firestop systems shall be installed to prevent or retard the spread of fire, smoke, water, and gases through the building. This requirement applies to openings designed for telecommunications use that may or may not be penetrated by cables, wires, or raceways.

B. Fire stops shall be done to applicable code.

3.30 WORKMANSHIP:

A. All work shall be done in a workman-like fashion of the highest standards in the telecommunications industry.

B. All equipment and materials are to be installed in a neat and secure manner, while cables are to be properly dressed.

C. Workers must clean any debris and trash at the close of each workday.

3.31 TESTING:

A. Testing of all newly installed cable channels shall be performed prior to system cutover.

B. Copper Testing:

1. All category 6 field-testing shall be performed with an approved level III balanced twisted-pair field test device.
    a. All installed category 6 channels shall perform equal to or better than the minimum requirements as specified by the following table:

Parameter	Performance @ 100MHz	Performance @ 200MHz	Performance @ 250MHz
Insertion Loss	19.0 dB	27.5 dB	31.0 dB
NEXT Loss	51.3 dB	46.8 dB	45.3 dB
PS NEXT Loss	49.3 dB	44.8 dB	43.3 dB
ACR	32.3 dB	19.3 dB	14.4 dB
PS ACR	30.3 dB	17.3 dB	12.4 dB
ACR-F	34.8 dB	28.7 dB	26.8 dB
PS ACR-F	31.8 dB	25.7 dB	23.8 dB
Return Loss	20.1 dB	18.0 dB	17.3 dB
Propagation Delay	538 ns	537 ns	536 ns
Delay Skew	45 ns	45 ns	45 ns

b. All balanced twisted-pair backbone cables exceeding 90 m (295 ft) or 100 m (328 ft) shall be 100% tested for continuity if applications assurance is not required.

c. Category 6 balanced twisted-pair horizontal cables, whose length does not exceed 90 m (295 ft) for the basic link, and 100 m (328 ft) for the channel shall be 100 percent tested according to ANSI/TIA/EIA-568-B.1. Test parameters include wire map plus ScTP shield continuity (when present), length, NEXT loss (pair-to-pair), NEXT loss (power sum), ELFEXT loss (pair-to-pair), ELFEXT loss (power sum), return loss, insertion loss, propagation delay, and delay skew.

C. Test Equipment Criteria:

1. All balanced twisted-pair field testers shall be factory calibrated each calendar year by the field test equipment manufacturer as stipulated by the manuals provided with the field test unit. The calibration certificate shall be provided for review prior to the start of testing.
   a. Autotest settings provided in the field tester for testing the installed cabling shall be set to the default parameters
   b. Test settings selected from options provided in the field testers shall be compatible with the installed cable under test.

3.32 ADMINISTRATION AND DOCUMENTATION:

A. Labeling

1. Horizontal and backbone cables shall be labeled at each end. The cable or its label shall be marked with its identifier.
   a. A unique identifier shall be marked on each faceplate to identify it
   b. Each port in the faceplate shall be labeled with its identifier.
   c. A unique identifier shall be marked on each piece of connecting hardware to identify it as connecting hardware.

d. Each port on the connecting hardware shall be labeled with its identifier.

B. Drawings

1. As-built drawings shall be supplied by the contractor showing the locations of and identifiers for all:
   a. Horizontal cable routing and terminations
   b. Telecommunications outlets/connectors
   c. Backbone cable routing and terminations

C. Records and reports

1. All records shall be created by the installation contractor and turned over at the completion of work
   a. The format shall be computer based and both soft copies and hard copies shall be part of the As-built package. The minimum requirements include:
   b. Cable records must contain the identifier, cable type, termination positions at both ends, splice information as well as any damaged pairs/conductors.
   c. Connecting hardware and connecting hardware position records must contain the identifier, type, damaged position numbers, and references to the cable identifier attached to it.
   d. Test documentation on all cable types shall be included as part of the As-built package.
   e. All reports shall be generated from the computer-based program used to create the records above. These reports should include but not limited to:
   f. Cable Reports
   g. Cross-connect Reports
   h. Connecting Hardware Reports

3.33 WARRANTY:

A. Either a basic link or channel model configuration may be applied to the horizontal and/or backbone sub-systems of the structured cabling system. Applications assurance is only applied to a channel model configuration. All channels are to be qualified for linear transmission performance up to 250 MHz to ensure that high-frequency voltage phase and magnitude contributions do not prove cumulative or adversely affect channel performance.

B. System Warranty:

1. A twenty (20) year warranty available for the category 6, structured cabling system shall be provided for an end-to-end channel model

installation which covers applications assurance, cable, connecting hardware, and the labor cost for the repair or replacement thereof.

a. Additional features of the warranty shall include:

b. Margin over category 6 channel specifications on all parameters across the entire frequency range of 1-250MHz as noted below:

Parameter	Guaranteed Margin 1-250MHz
Insertion Loss	4.3 – 8.1%
NEXT Loss	5.0 dB
PS NEXT Loss	7.0 dB
ACR	5.0 dB
PS ACR	7.0 dB
ACR-F	7.0 dB
PS ACR-F	9.0 dB
Return Loss	2.0 dB
Propagation Delay	0 ns
Delay Skew	5 ns

c. Performance claims based on worst case testing and channel configurations.

C. Product Warranty:

1. The manufacturer of passive telecommunications equipment used in a manner not associated with the Systems Warranty must have a minimum five (5) year Component Warranty on all its products.
2. The Products Warranty covers the components against defects in material or workmanship under normal and proper use.

D. Applications Supported:

1. Existing and future applications supported for a channel model warranty include those approved by the Institute of Electronic and Electrical Engineers (IEEE), the Asynchronous Transfer Mode (ATM) Forum, the American National Standards Institute (ANSI) or the International Organization of Standards (ISO) that specify compatibility with the cable referenced herein.

END OF SECTION

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SECTION 26 08 00

COMMISSIONING OF ELECTRICAL
(Filed Sub Bid Required as Part of Section 26 00 00)

PART 1 - GENERAL

1.01 SUMMARY

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 1 – GENERAL REQUIREMENTS, which are hereby made a part of this Section of the Specifications.

B. Section includes commissioning process requirements for Electrical systems, assemblies, and equipment.

A. **Work in this Section is included as part of the work in Section 26 00 00**.

1.02 RELATED SECTIONS

A. Section 01 77 00, PROJECT CLOSEOUT PROCEDURES.

B. Section 01 91 13, GENERAL COMMISSIONING.

C. Section 26 00 01, ELECTRICAL.

1.03 DEFINITIONS

A. Commissioning Plan: A document that outlines the organization, schedule, allocation of resources, and documentation requirements of the commissioning process.

B. CA: Commissioning Agent/Commissioning Authority. An entity who leads, plans, schedules and coordinates the Cx team to implement the Cx process.

C. Systems, Subsystems, Equipment, and Components: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, equipment, and components.

1.04 SUBMITTALS

A. Certificates of readiness.

B. Certificates of completion of installation, prestart, and startup activities.

1.05 ALLOWANCES

A. Labor, instrumentation, tools, and equipment costs for technicians for the performance of commissioning testing.

1.06 CONTRACTOR'S RESPONSIBILITIES

A. Perform commissioning tests at the direction of the CA.

B. Attend construction phase controls coordination meeting.

C. Attend testing, adjusting, and balancing review and coordination meeting.

D. Participate in Plumbing systems, assemblies, equipment, and component maintenance orientation and inspection as directed by the CA.

E. Provide information requested by the CA for final commissioning documentation.

F. Provide measuring instruments and logging devices to record test data, and provide data acquisition equipment to record data for the complete range of testing for the required test period.

1.07 COMMISSIONING AGENT'S RESPONSIBILITIES

A. Provide Project-specific construction checklists and commissioning process test procedures for actual HVAC&R systems, assemblies, equipment, and components to be furnished and installed as part of the construction contract.

B. Direct commissioning testing.

C. Verify testing, adjusting, and balancing of Work are complete.

D. Provide test data, inspection reports, and certificates in Systems Manual.

1.08 COMMISSIONING DOCUMENTATION

A. Provide the following information to the CxA for inclusion in the commissioning plan:
   1. Plan for delivery and review of submittals, systems manuals, and other documents and reports.
   2. Identification of installed systems, assemblies, equipment, and components including design changes that occurred during the construction phase.

3. Process and schedule for completing construction checklists and manufacturer's prestart and startup checklists for Electrical systems, assemblies, equipment, and components to be verified and tested.
4. Certificate of completion certifying that installation, prestart checks, and startup procedures have been completed.
5. Certificate of readiness certifying that Electrical systems, subsystems, equipment, and associated controls are ready for testing.
6. Test and inspection reports and certificates.
7. Corrective action documents.
8. Verification of testing, adjusting, and balancing reports.

PART 2 -PRODUCTS (NOT USED)

PART 3 -EXECUTION

3.01 TESTING

A. Prefunctional Checklists and Start-up:
   1. Follow the Start-up and initial checkout procedures listed in this Section and in Division 01. Start-up and complete systems and sub-systems so they are fully functional, meeting the requirements of the Contract Documents.
   2. Prefunctional Checklists shall be complete prior to commencement of a Functional Performance test.

B. Functional Performance Tests:
   1. Functional Performance Tests are conducted after system Start-up and checkout is satisfactorily completed.
   2. Contractor to provide FPTs for CA review prior to testing.

C. Coordination Between Testing Parties:
   1. Factory Start-ups: Factory Start-ups are specified for certain equipment. Factory Start-ups generally are Start-up related activities that will be reviewed and checked prior to Functional Performance Tests. All costs associated with factory Start-ups shall be included with the contract price unless otherwise noted. Notify the Commissioning Team of the factory Startup schedule and coordinate these factory Start-ups with witnessing parties. The Commissioning Team members may witness these Start-ups at their discretion.
   2. Independent Testing Agencies: For systems that specify testing by an independent testing agency, the cost of the test shall be included in the Contract price unless otherwise noted. Testing performed by independent agencies may cover aspects required in the Prefunctional Checklists, Start-ups, and Functional Performance Tests. Coordinate with the independent testing agency so that Owner and/or A/E can witness the test to ensure that applicable aspects of the test meet requirements.

D. Minimum Lighting Control Testing:
   1. Test lighting and controls systems performance to verify operation, functionality, light levels, energy usage, and compliance with construction documents.
   2. Contractor shall execute the Functional Performance Test (FPT) under the observation of the CA who will record the results of the FPT procedures.

E. Minimum Functions and Testing Conditions:
   1. Occupancy sensors and timer controls for lighting:
      a. Verify that all specified functions and features are set up, debugged and fully operable at time of test.
      b. Verify that occupant override feature functions properly and as intended in the contract documents.
      c. Verify that sensor durations are set properly.
      d. Test the sequence of operation for all features and modes and confirm that adjustable timing matches the design specifications and contract documents.
   2. Electric lighting dimming, photocells and controls:
      a. Test the dimming controls during daytime when conditions are such that controls should be dimming electric lighting. Verify that amperage changes in light fixtures are proportional to external light changes. Verify that dimmed light levels at the specified work plane remain within specified limits.
      b. Verify that delays and ramp times are set and functioning so that the speed of change of light fixture output is slow enough to not bother occupants and in compliance with the specifications.
      c. Verify that dimming does not cause lower than specified light levels in adjacent “nondimmed” spaces.
      d. Verify that the controls and sensors cannot be easily overridden or disabled by occupants.
      e. Verify that dimming systems in places of assembly are interfaced with the Central Fire Alarm system. Dimmed lighting in these areas shall come back to full bright during a fire alarm condition.
   3. Illumination Levels, Night Conditions:
      a. Verify that lighting throughout the building is operating automatically.
      b. Test with doors closed (to simulate actual occupancy) and after finishes are complete.
   4. Illumination Levels, Day Conditions:
      a. Verify that lighting throughout the building is operating automatically.
      b. Test with doors closed (to simulate actual occupancy), after finishes are complete, and room is furnished.
      c. Test at different times during the day, or under Owner-approved simulated conditions, to ensure proper system response and to determine that lighting levels are within specified requirements.
      d. Test the system for the different pre-determined settings. AV mode, and normal standard class operation.
   5. Lighting Power Density: Perform the test with all interior lighting turned on and any manual or automatic controls temporarily overridden. The lighting power

shall be measured at the building's electrical panels. Measurements shall be taken at least one (1) minute after all lighting in the building is on.

F. Acceptance Criteria:
   1. Lighting Controls: For the conditions, sequences and modes tested, the dimming/occupancy/photocell/timing controls, integral components and related equipment respond to changing conditions and parameters appropriately as defined in the Contract Documents.
   2. Illumination Levels: Average light levels in the tested space at the work plane elevation shall not be less than 10% below nor greater than 10% above the specified light level range for the space.
   3. Lighting Power Density: Average instantaneous lighting power density is +/- 10% of that indicated in the Construction Documents. Power factors on lighting circuits shall be 0.95, or as required by lighting fixture specifications.
G. Sampling Strategy for Identical Units:
   1. Lighting Controls: Test all automatic interior lighting controls.
   2. Illumination Levels: At least 50% of all space zones and rooms, chosen by the Owner, shall be verified as realizing proper light levels. If 25% of the spaces in the first sample fail the Functional Performance Tests, test another 25% of the untested space zones and rooms (the 2nd sample). If 10% of the spaces in the 2nd sample fail, test all remaining spaces.
   3. Power Density: Test all lighting circuits.

END OF SECTION

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SECTION 31 10 00
SITE CLEARING

PART 1 - GENERAL

1.01 PROVISIONS INCLUDED

A. 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. Protecting existing trees and grass to remain.
2. Removing existing trees and grass.
3. Clearing and grubbing.
4. Stripping and stockpiling topsoil.
5. Removing above- and below-grade site improvements including existing pavements and curbs.
6. Temporary erosion and sedimentation control measures.
7. Removing existing foundations and slabs.
8. Disconnecting, capping or sealing, abandoning site utilities in place, and removing site utilities.
9. Temporary erosion and control measures.

B. Related Sections include the following:
1. Division 01 Section "Temporary Facilities and Controls" for temporary utilities, temporary construction and support facilities, temporary security and protection facilities.
2. Division 01 Section "Temporary Tree and Plant Protection" for protecting trees remaining on-site that are affected by site operations.
3. Division 01 Section "Execution" for verifying utility locations and for recording field measurements.
4. Division 31 Section "Earth Moving" for soil materials, excavating, backfilling, and site grading.
5. Division 23 Section "Turf and Grasses" and "Plants" for finish grading including preparing and placing planting soil mixes and testing of topsoil material.

1.03 DEFINITIONS

A. Topsoil: Natural or cultivated surface-soil layer containing organic matter and sand, silt, and clay particles; friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects more than 2 inches in diameter; and free of subsoil and weeds, roots, toxic materials, or other nonsoil materials.

B. Tree Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction, and defined by the drip line of individual trees or the perimeter drip line of groups of trees, unless otherwise indicated.

1.04 MATERIAL OWNERSHIP

A. Stripped topsoil and cleared materials shall become Contractor's property and shall be removed from Project site.

1.05 SUBMITTALS

A. Record drawings, according to Division 01 Section "Project Record Documents," identifying and accurately locating capped utilities and other subsurface structural, electrical, and mechanical conditions.

B. Location plans for contractor parking, staging areas and schedule for moving staging equipment. Submit for Architects and Owners approval prior to mobilization and related site preparation operations.

C. Plan and schedule for tree removal and stockpiling.

1.06 PROJECT CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.
   1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
   2. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.

B. Improvements within Town ROW, Police Station property, and Turners Falls Water District (Fire Department) property: Authority for performing site clearing indicated within Town ROW, Police Station Property, and Turners Falls Water District properties will be obtained by Owner before award of Contract.
   1. Do not proceed with work within the Town ROW or these properties until directed by Architect.

C. Salvable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises where indicated.

D. Utility Locator Service: Notify utility locator service for area where Project is located before site clearing.

E. Do not commence site clearing operations until temporary erosion and sedimentation control measures are in place.

PART 2 - PRODUCTS

2.01 SOIL MATERIALS

A. Satisfactory Soil Materials: Requirements for satisfactory soil materials are specified in Division 31 Section "Earth Moving."

1. Obtain approved borrow soil materials off-site when satisfactory soil materials are not available on-site. On-site materials must also be approved for reuse.

PART 3 - EXECUTION

3.01 PREPARATION

A. Protect and maintain benchmarks and survey control points from disturbance during construction.

B. Locate and clearly flag trees and vegetation to remain or to be relocated.

C. Protect existing site improvements to remain from damage during construction.
1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.02 TEMPORARY EROSION AND SEDIMENTATION CONTROL

A. Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to sediment and erosion control drawings and the project Stormwater Pollution Prevention Plan (SWPPP).

B. Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.

C. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal upon approval of the Architect.

D. Relocate or provide additional erosion and sedimentation controls as necessary to complete the work.

3.03 UTILITIES

A. Locate, identify, disconnect, and seal or cap off utilities indicated to be removed.
1. Arrange with utility companies to shut off indicated utilities.

B. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
1. Notify Architect not less than seven days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Architect's written permission.

C. Verify that existing utilities indicated for removal do not service facilities to remain prior to removing utilities.

D. Excavate for and remove underground utilities indicated to be removed.

3.04 CLEARING AND GRUBBING

A. Remove obstructions, trees, shrubs, grass, and other vegetation to permit installation of new construction.
   1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.
   2. Cut minor roots and branches of trees indicated to remain in a clean and careful manner where such roots and branches obstruct installation of new construction.
   3. Grind stumps and remove roots, obstructions, and debris extending to a depth of 18 inches below exposed subgrade.
   4. Use only hand methods for grubbing within tree protection zone.

B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material as indicated in Division 31 Section "Earth Moving" unless further excavation or earthwork is indicated.
   1. Place fill material in horizontal layers not exceeding a loose depth of 8 inches, and compact each layer to a density equal to adjacent original ground.

3.05 TOPSOIL STRIPPING

A. Remove sod and grass before stripping topsoil.

B. Strip topsoil to whatever depths are encountered in a manner to prevent intermingling with underlying subsoil or other waste materials.

C. Stockpile topsoil materials away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust.
   1. Limit height of topsoil stockpiles to 72 inches.
   2. Do not stockpile topsoil within tree protection zones.
   3. Do not stockpile topsoil within 100 feet of Wetlands or within the Riverfront Area.
   4. Dispose of excess topsoil as specified for waste material disposal.

D. Deliver excess topsoil to a location within the Town limits of Montague, as directed by the Owner's Representative.

3.06 SITE IMPROVEMENTS

A. Remove existing above- and below-grade improvements as indicated and as necessary to facilitate new construction.

B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.
   1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut length of existing pavement to remain before removing existing pavement. Saw-cut faces vertically.
   2. Paint cut ends of steel reinforcement in concrete to remain to prevent corrosion.

3.07 SALVAGED SITE IMPROVEMENTS

A. Salvage, protect and store the following and as identified within the Drawings.

B. Document by photography or other method approved by the Architect of each salvaged item prior salvaging operations. Provide documents to the Owner and Architect.

C. Document method of storage and location of each salvaged item. Provide documents to the Owner and Architect.

3.08 DISPOSAL

A. Disposal: Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property, in accordance with local, state, and federal codes and regulations.
   1. Separate recyclable materials produced during site clearing from other nonrecyclable materials. Store or stockpile without intermixing with other materials and transport them to recycling facilities.

END OF SECTION 31 10 00

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SECTION 31 20 00
EARTH MOVING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Procurement and Contracting Requirements and Division 01 General Requirements apply to this Section.

1.02 SUMMARY

A. Work Included: Provide all labor, equipment and materials and do all work necessary to complete the site earthwork which includes, but is not necessarily limited to, the following:
1. Preparing subgrades for foundations, slabs-on-grade, walks, pavements, lawns and grasses.
2. Excavation and backfilling for buildings and structures.
3. Excavation and backfill for building footings and foundations including excavation of existing fills and site structures, including manholes, catch basins, utility structures, utility pipes and foundations.
4. Base course for slabs-on-grade.
5. Subbase course for concrete walks.
6. Subbase and base course for asphalt paving.
7. Subsurface drainage backfill for walls and trenches.
8. Excavating and backfilling for utility trenches.
9. Excavating and backfilling trenches for buried electrical utilities.
10. Excavation and backfilling for pits for buried utility structures and site lighting.
11. Removal and replacement of unsuitable soils.
12. Sheeting, bracing, and support of excavations as necessary.
13. Slope stabilization and treatment.
14. Drainage and dewatering as necessary to perform work in the dry.
15. Removal of existing topsoil, subsoil, fills and asphalt,
16. Placement and compaction of fills.
17. Moisture conditioning of materials to permit proper placement and compaction as specified.
18. Excavation and removal of boulders not classified as rock excavation.
19. Protection of existing structures, utilities and landscape.

B. Related Sections include the following:
1. Division 00 Document "Geotechnical Data" for test boring logs and test pit logs.
2. Division 01 Section "Unit Prices" for unit prices.
3. Division 01 Section “Construction Progress Documentation” for recording pre-excavation and earthwork progress.
4. Division 01 section "Temporary Facilities and Controls" for temporary controls, utilities, and support facilities.
5. Division 01 Section “Temporary Tree and Plant Protection” for protecting and trimming trees to remain.
6. Division 01 Section “Stormwater Pollution Prevention Plan”.

7. Division 31 Section “Site Clearing” for temporary erosion and sedimentation control measures, site stripping, grubbing, stripping and stockpiling topsoil, and removal of above and below-grade improvements and utilities.
8. Division 32 Section “Turf and Grasses” for amendments to topsoil.

1.03 REFERENCES

A. Comply with applicable requirements of the following standards. Where these standards conflict with other specified requirements, the most restrictive requirements govern.

B. American Society for Testing and Materials (ASTM):
1. ASTM C136, Sieve Analysis of Fine and Coarse Aggregates.
2. ASTM D1556, Density of Soil In Place by the Sand-Cone Method.
3. ASTM D1557, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3 (2,700 kN-m/m^3)).
4. ASTM D6938, Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).
5. ASTM D422, Particle Size Analysis of Soils.

C. Commonwealth of Massachusetts:
1. Massachusetts Highway Department, “Standard Specifications for Highways and Bridges.”
2. Commonwealth of Massachusetts Building Code.

D. American Association of State Highway and Transportation Officials (AASHTO):
1. AASHTO T-11, Standard Method of Test for Amount of Material Finer than 0.075 mm sieve in aggregate.
2. AASHTO T-27, Standard Method of test for sieve analysis of fine and coarse aggregates.

E. Occupational Safety and Health Act of 1970 (Public Law 91-596 of the United States, 29 USC Section 651 et seq.).

1.04 DEFINITIONS

A. Excavation Classifications:
1. General excavation includes off-site disposal of unsuitable materials not otherwise used on-site. General excavation includes all excavation on-site including but not limited to:
    a. Excavation of Unsuitable Material.
    b. Excavation of soil not suitable for reuse.
    c. Excavation for Pavements.
    d. Excavation for Structures
    e. Trench Excavation for Pipes and Conduits.
2. Earth Excavation: Excavation of all soil and existing pavement, utilities, foundations, slabs and other items indicated to be demolished. Earth excavation also includes excavation for landscaped areas.
3. Finished Grade: Required final grade elevations as indicated on the Drawings. Spot elevations govern over proposed contours. Uniformly slope project site areas between proposed finished grades or between proposed and existing grades.

4. Subgrade: Required surface of natural soil, borrow fill or compacted fill. This surface is immediately beneath proposed topsoil, concrete and bituminous base course or other surfacing material.
5. Unsuitable Material/Unsuitable Soil: Debris piles, existing fill, topsoil, subsoil, organic soil, frozen soil, soil containing debris, existing asphalt, utilities, foundations, and structures which is located within the zone of influence of buildings, slabs, footings and site structures or within 10 feet of the building footing, whichever is greater. Unsuitable material under proposed pavement areas consists of topsoil, subsoil, organic soil, frozen soil, soil containing debris, existing fill, existing asphalt, utilities, foundations, and structures.
6. Trench: Excavations having vertical sides the depth of which exceeds the width, made for utility excavations and the like.
7. Conventional Boulder Excavation: Boulders encountered during open excavation or in trenches which can be excavated using conventional equipment with minimal over excavation and disturbance of natural soils. Conventional Boulder Excavation is not considered Rock Excavation.

B. Backfill: Soil material or controlled low-strength material used to fill an excavation.
1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
2. Final Backfill: Backfill placed over initial backfill to fill a trench.

C. Base Course: Course placed between the subbase course and hot-mix asphalt paving or slab-on-grade.

D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill. Imported fill should meet the gradation requirements set forth in Section 2.01.

E. Bedding Course: Course placed over the excavated subgrade in a trench before laying pipe.

F. Fill: Soil materials used to raise existing grades.

G. Soils for Re-Use: Natural, on-site sand deposits in its present state are not acceptable as structural fill. On site natural sands can be mixed with imported coarse aggregate to produce a well-graded mixture suitable for placement as structural fill provided it meets the gradation for structural fill and are maintained at suitable moisture contents for proper compaction.

H. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

I. Subbase Course: Course placed between the subgrade and base course for hot-mix asphalt pavement, or course placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.

J. Subsoil: Existing fill soil between topsoil and granular soil (fill or natural), or existing fill soil between grade and granular soil (fill or natural) where no topsoil exists.

K. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below subbase, drainage fill, or topsoil materials.

L. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

M. Rock Excavation for trenches and pits includes removal and disposal of materials and obstructions encountered that cannot be excavated with a track-mounted power excavator, equivalent to Caterpillar Model No. 235, and rated at not less than 115 HP flywheel power and 32,000-pound drawbar pull and equipped with a short stick and a 42-inch wide, short tip radius rock bucket rated at 0.81 cubic yard (heaped) capacity. Trenches in excess of 10 feet in width and pits in excess of 30 feet in either length or width are classified as open excavation.

N. Rock Excavation in open excavations includes removal and disposal of materials and obstructions encountered that cannot be dislodged and excavated with modern, track-mounted, heavy- duty excavating equipment without drilling, blasting, or ripping. Rock excavation equipment is defined as Caterpillar No. 235 or equivalent track-mounted excavator, rated at not less than 210 HP flywheel power and developing minimum of 45,000-pound breakout force (measured in accordance with SAE J732).
   1. Typical of materials classified as rock include solid rock, rock in ledges, and rock- hard cementitious aggregate deposits.
   2. Intermittent drilling, blasting, or ripping performed to increase production and not necessary for excavation will be classified as earth excavation.

O. Oversized Boulder Excavation: Large boulders encountered during open and trench excavation which require methods normally used for rock excavation in order to minimize disturbance to surrounding natural soils. These methods may include drilling and wedging, jack hammering, the use of headache balls or ram hoes, or other approved methods. Oversized boulders are classified as Rock Excavation. Oversized boulder size is defined as follows:
   1. Trench Excavation: Greater than one cubic yard.
   2. Open Excavation: Greater than two cubic yards.

P. Over-Excavation: Excavation required beyond excavation to subgrade as indicated by the lines and grades herein or as indicated on the Drawings (whichever is deeper). Over-excavation is excavation below subgrade and below the top 12 inches of soil (including topsoil/subsoil/fill) to the bottom of the unsuitable soils.

Q. Zone of Influence: The area bounded by a one horizontal to one vertical (1H:1V) line sloping downward and outward from the bottom of the exterior footings or for a distance of 10 feet from outside face of footing, whichever is greater.

1.05 SUBMITTALS

A. Product Data for the following:
   1. Each type of detectable warning tape.
   2. Geotextile.

B. Sample: 12” by 12” sample of geotextiles.

C. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated:

1. Classification according to ASTM D 2487 of each on-site and borrow soil material proposed for fill and backfill.
2. Recent (within 1 month) laboratory compaction curve according to ASTM D 1557 for each on-site and borrow soil material proposed for fill and backfill.
3. Recent (within 1 month) laboratory particle size distribution analysis according to ASTM D422.
4. Soil tests in accordance with the anti-degradation provisions of the MCP, 310 CMR 40.0032(3)

D. Submit a representative fifty pound (50-lb.) sample of each type of fill material, in air-tight containers, proposed for use as Structural Fill or Base Course Sand and Gravel Fill within the proposed building or pavement areas, to the Owner's Geotechnical Consultant for physical testing at least two (2) weeks prior to use. No fill material shall be delivered to the site or placed until the material has been approved.
1. For off-site materials, submit the name of each material supplier with specific type and source of each material. Any change in type or source of material during the work requires the written approval of the Owner or the Engineer.
2. For on-site materials, submit representative samples, collected from each stockpile of excavated on-site material to be used, directly to the Owner's Geotechnical Consultant's office at least two (2) weeks in advance of use of these materials.

E. Off-site Soil Disposal Location: Submit for review.
1. Soil tests of soil for off-site disposal location in accordance with the anti-degradation provisions of the MCP, 310 CMR 40.0032(3)
2. Acceptance of soil by owner of Off-Site Soil Disposal Location.

F. Dewatering Plan.

1.06 QUALITY ASSURANCE

A. The Owner may retain a Geotechnical Consultant to perform on-site observation and testing during construction operations. The services of the Owner's Geotechnical Consultant may include, but not be limited to the following:
1. Laboratory testing and analysis of fill and bedding materials specified, as required.
2. Observation during excavation and dewatering within controlled fill areas.
3. Observation during backfilling and compacting operations within controlled fill areas and other areas as appropriate.
4. Observation and assessment of bearing surfaces.
5. Observe construction and perform water content, gradation and compaction tests at a frequency and at locations as required. The results of these tests will be submitted to the Architect, copy to the Contractor, on a timely basis so that the Contractor can take such action as is required to remedy the indicated deficiencies.
6. Observation of rock removal, if required.

B. The Owner's Geotechnical Consultant's presence does not include supervision or direction of work by the Contactor, his/her employees or agents. Neither the presence of the Owner's Geotechnical Consultant nor any observations performed by him/her, or any notice or failure to give notice, shall excuse the Contractor from deficiencies in the work.

C. The Owner reserves the right to modify the Owner's Geotechnical Consultant services.

D. Test soils shall be in accordance with the following:

Property	ASTM Test Method
Particle-Size Analysis	D422
Soil Density (In Place)	D1556 or D6938
Moisture-Density	D1557

E. Excavation and Handling of Material for Off-Site Disposal: Coordinate disposal activities as required to complete the work described in this section. Legally dispose of unsuitable excavated materials requiring special handling:
   1. Contractor is responsible for sampling and testing materials to assess the disposal requirements; include testing for arsenic in accordance with the anti-degradation provisions of the MCP, 310 CMR 40.0032(3).
   2. Contractor is responsible for the disposal of materials which require off-site transportation (special handling) under a Bill of Lading and/or Uniform Hazardous Waste Manifest under regulations of the Massachusetts Department of Environmental Protection (DEP).

1.07 PROJECT CONDITIONS

A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted in writing by Architect and then only after arranging to provide temporary utility services according to requirements indicated.
   1. Notify Architect not less than two days in advance of proposed utility interruptions.
   2. Do not proceed with utility interruptions without Architect's written permission.
   3. Contact utility-locator service for area where Project is located before excavating.

B. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies to shut off services if lines are active.

C. Protect nearby structures from damage. All construction induced damage shall be repaired by the Contractor at no additional expense to the Owner.

D. The Contractor shall obtain and pay for all permits and licenses required to complete the work of this Section.

E. In case of conflict between regulations or between regulations and Specifications, the Contractor shall comply with the strictest applicable codes, regulations, or Specifications.

F. The contractor may perform additional test borings and other explorations at no cost to the Owner.

1.08 SEQUENCING AND SCHEDULING

A. As construction proceeds, notify the Architect prior to the start of earthwork operations which require observations and testing. A minimum of 72 hours notification shall be provided for work that requires observation or testing.

B. Coordinate the installation of the new utilities with existing utility locations. Notify Architect if a conflict with existing utilities restricts the installation of new utilities.

1.09 PROJECT RECORD DOCUMENTS

A. Submit copies of project records and drawings.

PART 2 - PRODUCTS

2.01 SOIL MATERIALS

A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from on-site excavations. Recycled construction materials, including crushed concrete and masonry, and other than pulverized pavement, are prohibited for use as imported soil or backfill.

B. On-site material for use as compacted fill consisting of inorganic, granular soil, taken from areas of excavation after stripping of topsoil, subsoil, asphalt, and removal of unsuitable material that are at suitable moisture content to allow for proper placement and compaction as specified herein.

1. Excavate soil materials to be used as fill or backfill, based on information submitted by the Contractor to Architect, in accordance with current environmental practice in the Commonwealth of Massachusetts.
2. Materials may be rejected for use based on the results of the evaluation. Remove rejected material to off-site location at the Contractor's expense.
3. Provide regular samples to the Owner's Geotechnical Engineer and particle size distribution analysis to Architect to review at approximately every 200 cubic yards.
4. Pulverized on-site pavement may not be used as fill or backfill material on the site.
5. Crushed concrete is not to be used as backfill on the site.

C. Material containing organic matter, topsoil, organic silt or peat is unsuitable for use as fill or backfill in building or paved areas or for fill or backfills for structures or utilities. Topsoil may be reused in landscape areas as the upper layer for planting, provided it is screened and amended to meet the requirements specified in Section 32 92 00, Turfs and Grasses.

D. Fill material shall be free from frost/ice and snow, rocks with a diameter greater than 2/3 of the loose lift thickness as specified herein, and foreign matter, such as construction debris, asphalt, trash, wood, roots, leaves, sod, and organic matter. All fill material shall be maintained by the contractor at suitable moisture contents for proper placement and compaction as specified herein.

E. Off-site pulverized pavement and off-site crushed concrete are not acceptable for fill material.

F. Fills used below subgrade within the infiltration basin shall be on-site excavated sand meeting contract requirements.

G. Grade fill material within the specified limits. Determine gradation of materials in accordance with ASTM D422.
1. Base Course Sand & Gravel Fill (Gravel Base Course): Base course layer beneath the interior floor slab-on-grade, beneath pavement, beneath sidewalks, beneath equipment

pads, and for subgrade stabilization. It shall consist of durable sand and gravel and shall be free from ice, snow, roots, sod, rubbish, and other deleterious or organic matter graded within the following limits:

Sieve Size	% Passing by Weight
3-inch	100
1½-inch	70-100
3/4- inch	50-85
No.4	40-75
No. 10	30-60
No.200	2-10

2. ¾" Crushed Stone: To be used beneath footings to protect subgrade and around, and as required per contract documents. It shall consist of durable crushed rock or durable crushed gravel stone and shall be free from ice and snow, roots, sob, rubbish, and other deleterious or organic matter graded within the following limits:

Sieve Size	% Passing by Weight
1-inch	100
¾-inch	90-100
½-inch	10-50
3/8-inch	0-20
No.4	0-5

3. Common Fill: To be used as fill in proposed landscaped areas and more than 5 feet below finished grade in proposed paved areas. It shall consist of inorganic soil excavated from on-site locations that is free of ice, snow, roots, sod, loam, organics, rubbish, debris and other deleterious matter. It shall be graded within the following limits:

Sieve Size	% Passing by Weight
2/3 loose lift thickness	100
No. 4	30-95
No. 200	0-35

4. Granular Fill (Structural Fill): To be used for general raises in grade in proposed building and pavement areas or as backfill in these areas. Material shall be free from ice, snow, roots, sod, rubbish, and other deleterious or organic matter graded within the following limits:

Sieve Size	% Passing by Weight
3 inch	100
1/2 -inch	50-85
No.4	40-75
No.50	8-28
No.200	0-8

5. Sand Fill: To be used as utility bedding and backfill. It shall be hard, durable sand free from ice, snow, roots, sod and other deleterious matter conforming to the material and

gradation requirements for Type B Sand Borrow, MassDOT Item M1.04.0 within the following limits:

Sieve Size	% Passing by Weight
3/8-inch	100
No.200	0-10

6. Dense Graded Aggregate: Material free from frozen soil, roots, sod, rubbish and other deleterious or organic matter, graded within the following limits:

Sieve Size	% Passing by Weight
2 inch	100
1-½ inch	70-100
3/4 inch	50-85
No. 4	30-55
No. 50	8-24
No. 200	3-10

7. 4" Rip-Rap: To be used at the construction entrance. It shall be inorganic soil that is free from ice and snow, roots sod, and other deleterious matter that conforms to the following limits:

Sieve Size	% Passing by Weight
4-inch	100
2.5-inch	0-5

2.02 ACCESSORIES

A. Detectable Warning Tape: Acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored as follows:
   1. Red: Electric.
   2. Yellow: Gas.
   3. Orange: Telephone and other communications.
   4. Blue: Water systems.
   5. Green: Sewer systems.

B. Geotextile for Riprap: This geotextile is to be used at all filter fabric/ geotextile applications noted on the drawings except for the infiltration system as noted in 2.02.C. Non-woven polypropopylene fabric having a Puncture Resistance (ASTM D4833) of at least 110 pounds and an Apparent Opening Size (ASTM D4751) of 0.15 to 0.22 millimeters or less. Mirafi 180N, ADS Geosynthetics 0451T, or Geotex 601 by Propex..

PART 3 - EXECUTION

3.01 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, excessive vibrations, and other hazards created by earthwork or rock removal operations.

B. Preparation of subgrade for earthwork operations including removal of vegetation, topsoil, debris, obstructions, and deleterious materials from ground surface is specified in Division 31 Section "Site Clearing."

C. Protect and maintain erosion and sedimentation controls, which are specified in Division 01 Section "Temporary Erosion and Sedimentation Control," during earthwork operations.

D. Perform preconstruction survey of adjacent structures as described herein. Prior to the start of earthwork activities, the Contractor shall hire a qualified, independent firm to conduct pre-construction survey of structures in the area in accordance with 527 CMR 13.00. Submit two (2) copies of the preconstruction survey reports to the Owner prior to commencement of the work. Surveys should include, at a minimum, a narrative video tape of external and internal (if possible) conditions of each structure surveyed.

E. Notify the Architect at least forty-eight (48) hours before any intended rock removal.

F. Notify owners of adjacent buildings or structures, including subsurface utilities as specified in Division 31 section “Earth Moving”.

G. The Contractor shall present evidence that his insurance includes coverage for rock removal operations for this project such as blasting before commencing rock removal work. Submit a certificate of insurance documenting that liability insurance coverage in an amount no less than $2,000,000 will be in force for the duration of blasting at the site. The Contractor shall ensure that all damage claims will be honored, pursuant to the terms of the insurance policies and/or applicable state law.

3.02 DEWATERING

A. Groundwater was encountered at varying depths below the existing ground surface in some of the test pits locations at the site. Groundwater levels will vary depending on seasonal variations in temperature and precipitation. It should be anticipated that dewatering may be required during construction. Groundwater is to be lowered below subgrade level prior to excavating for footing and placement of fill, if required. In these areas, the size of the excavation open at any time should be limited to that which can be adequately handled by the Contractor’s chosen dewatering methods.

B. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.

C. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.

1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.
2. Install a dewatering system to keep subgrades dry and convey ground water away from excavations, if required. Maintain until dewatering is no longer required.

3.03 PROTECTION OF EXISTING STRUCTURES AND UTILITIES

A. Execute the Work in such a manner as to prevent damage to adjacent property and other property and existing improvements such as, but not limited to, buildings, streets, curbs, paving, utility lines and structures, monuments, bench marks and other public and private property. Protect existing structures and foundations from damage caused by settlement, lateral movement, undermining, washout, vibrations, and other hazards created by earthwork and rock removal operations.

B. In case of any damage or injury caused in the performance of the work, make good such damage or injury to the satisfaction of, and without additional cost to the Owner. Repair or replace existing roads, sidewalks, and curbs damaged during the project work to their original condition at the completion of operations. Replace existing benchmarks, monuments, and other reference points which are disturbed or destroyed.

3.04 PROTECTION OF EXISTING LANDSCAPE

A. Exercise care to preserve the natural landscape and conduct construction operations so as to prevent destruction, scarring, or defacing of the natural surroundings in the vicinity of the Work.
1. Except where clearing is required for permanent works, protect trees, shrubbery, and vegetation from damage which may be caused by the Contractor's construction operations. Protect existing trees to remain from damage with fencing or other means acceptable to the Architect.
2. Move crews and equipment within the right-of-way and over routes provided for access to the work in a manner which prevents damage to property. Where unnecessary destruction, scarring, damage, or defacing occurs as a result of the Contractor's operations, repair, replant, reseed, or otherwise correct the damage at no expense to the Owner.

3.05 SHORING

A. Open excavations in general should have side slopes conforming to applicable OSHA standards. Provide shoring and/or bracing at the Contractor's expense and designed by a Professional Engineer.

B. Provide shoring and/or bracing at excavations as required to assure safety against collapse of earth at the sides of excavations; as required for support of adjacent structures, streets or utilities; or as required to comply with Federal, State, and local regulations codes or ordinances.

C. Carefully remove all shoring and bracing not ordered left in place in such a manner as to not endanger the construction of other structures, utilities or property whether public or private. Immediately refill all voids left after withdrawal of shoring with sand and rammed with tools

especially adapted to that purpose or otherwise compacted as directed to achieve the required density.

3.06 GENERAL EXCAVATION

A. Brace, underpin and support structures, pipes, pavement, earth, and other property susceptible to damage from excavation operations as required to prevent damage and movement.

B. As excavation approaches underground utilities and structures, excavate using hand tools. Such manual excavation is incidental to normal excavation and no special payment will be made.

C. Carry excavation for pipe and other items far enough below underside of item to accommodate bedding material.

D. Fill excavations which extend below indicated or specified levels ("over-excavation") to those levels with compacted Granular Fill, Sand and Gravel, or Crushed Stone at no cost to the Owner. Material used to backfill over-excavation in the area of infiltration basin shall meet soil requirements of 310 CMR 15 (Title 5).

E. If bearing surface of subgrade which is to receive fill, structure, concrete, or other construction becomes softened, disturbed, or unstable, remove unsuitable material down to a firm bearing surface and replace with suitable compacted material. Protect subgrade from further disturbance until construction item is placed. Do not excavate wider than required to set, brace, and remove forms for concrete, install structures, piping, or perform other necessary work unless otherwise specified. Width of trench at 12 in. above top of pipe or conduit is not greater than the sum of outside diameter of the pipe or the conduit plus 2 ft. (pipe O.D. + 2 ft.). Slope sides of trench above this level, at an angle 45 degrees or less from vertical, from this level to grade. In materials where sloping walls are not stable, brace trench walls to prevent sloughing and collapse.

F. Frost and Wet Weather: Do not excavate to full indicated depth when freezing temperatures or wet weather may be expected unless concrete can be poured immediately after the excavation has been completed. Protect the excavation from frost and wet weather if placement of concrete is delayed. Where concrete is exposed to freezing temperatures, protect to prevent frost penetration into the soil below.

Do not place controlled compacted fill over frozen soil. Remove soil that is frozen prior to placement and compaction of fill. Remove all frozen soil prior to placing additional fill for compaction.

G. Remove existing asphalt pavement from proposed construction areas as indicated on the plans. The existing asphalt pavement is to be excavated and disposed of off-site in accordance with local, state and federal regulations at no additional cost to the owner.

H. Existing utilities within the zone of influence of the proposed building shall be removed or relocated as appropriate outside of the proposed building footprint. Any abandoned utilities, structures, and foundations located beneath the building footprint are to be excavated and

replaced with compacted Granular Fill or Base Course Sand & Gravel Fill as specified herein. Crushed stone shall be used as backfill if in a "wet" condition.

I. The existing concrete slab on grade and footings from the demolished portion of the existing buildings are to be completely removed during the applicable project phase. Excavations to remove the existing footings are to be backfilled with Granular Fill or Base Course Sand & Gravel Fill placed in lifts and compacted as specified herein. Use Crushed Stone for backfill if in a "wet" condition.

J. Excavated on-site materials are potentially suitable for Re-Use as Common Fill in landscaped areas. Reuse of on-site materials must meet the following:
   1. Stockpile and maintain Soils for Re-Use at suitable moisture contents for proper compaction.
   2. Test Soils for Re-Use for particle size, soil density and moisture-density in accordance with this specification.
   3. Do not comingle soils that meet different fill material gradation requirements.
   4. Submit test results to Architect for approval of re-use.

3.07 EXCAVATION OF UNSUITABLE MATERIAL

A. General: Excavate all unsuitable material to firm natural ground within the zone of influence of structures in the manner specified below and in the Contract Drawings. Unsuitable material is defined in Paragraph 1.04.A.5. Unsuitable soils encountered within the proposed building area shall be completely removed to firm natural ground to at least 10 feet beyond the proposed building limits and exterior canopy columns or within the area bounded by a one horizontal to one vertical (1H:1V) line sloping downward and outward from proposed bottom of exterior footing to firm natural ground, whichever is greater.

B. Follow a construction procedure which permits visual identification of firm natural ground. In the event that groundwater is encountered, the Engineer may require that the size of the open excavation be limited to that which can be handled by the Contractor's chosen method of dewatering and which will allow visual observation of the bottom and backfilling in the dry.

C. The Contractor shall be required to immediately place a 12 to 18 inch thick layer of Sand and Gravel or 6 to 12 inches of crushed stone over the natural underlying soil to stabilize areas which become disturbed as a result of groundwater.

Prior to placing the initial layer of fill over the natural ground, proofroll the exposed natural ground, above the groundwater level, by making at least 4 passes of a vibratory drum roller having a minimum drum width of 8 feet and a rated dynamic weight of a minimum of 20 tons. If soft or unstable areas are detected during proofrolling, over excavate and replace with controlled, compacted Granular Fill as necessary.

3.08 EXCAVATION FOR PAVEMENT

A. Remove existing surface and near surface topsoil, subsoil and organic soils as well as existing structures and asphalt from below proposed pavement. Existing fill below proposed pavement is to be removed to within 60" inches of final grade. Existing fills below 60" of final grade in pavement areas may remain in-place provided it meets the material

requirements for Common Fill, and provided that buried organic soils are not present, and provided that the fill is densified in-place by proofrolling with at least 4 passes of a 20 ton vibratory roller. If soft or unstable areas are detected during proofrolling, overexcavate and replace with controlled compacted Granular Fill as necessary.

B. Excavate surface under pavements to comply with cross-sections, elevations and grades as indicated.

C. Remove abandoned utility pipes located within 18-inches of pavement base course elevations. Cap the ends of abandoned utility pipes left in-place.

3.09 EXCAVATION FOR FOUNDATIONS

A. Recompact disturbed earth with at least 2 passes of a vibratory plate or drum compactor.

B. If groundwater is encountered or during wet weather, immediately place a 6 inch minimum layer of compacted crushed stone. Over excavate as required.

C. Rock encountered at or above bottom of footing shall be overexcavated at least 18 inches and loose or shaken rock shall be removed. The overexcavated zone shall be replaced with compacted Granular Fill, Sand and Gravel, or Crushed Stone.

D. If footings are located over existing utilities, remove utility and backfill the excavation with compacted Granular Fill. Remove existing utilities below the floor slabs. Refer to Paragraph 3.06H.

3.10 TRENCH EXCAVATION FOR PIPES AND CONDUIT

A. Excavate trenches to uniform width, sufficient to provide working room and a minimum of 12 inches of clearance on both sides of pipe or conduit.

B. Excavate trenches and conduit to depth indicated or required to establish indicated slope and invert elevations and to support bottom of pipe or conduit on undisturbed soil.
   1. For pipes or conduit less than 6 inches in nominal size, and for flat-bottomed, multiple-duct conduit units, do not excavate beyond indicated depths. Hand-excavate bottom cut to accurate elevations and support pipe or conduit on undisturbed soil.

C. For pipes and equipment 6 inches or larger in nominal size, shape bottom of trench to fit bottom of pipe for 90 degrees (bottom 1/4 of the circumference). Fill depressions with tamped sand backfill. At each pipe joint, dig bell holes to relieve pipe bell of loads ensure continuous bearing of pipe barrel on bearing surface.

3.11 BACKFILL AND COMPACTION

A. Backfill excavations below finished grade. Remove temporary planking, timbering, forms, debris, and refuse before backfill is placed.

B. Backfill after the Architect or Owner's Geotechnical Consultant has observed and approved operations. Give prompt notice that the work is ready for observation, and allow sufficient time for making necessary observations.

C. In order to prevent lateral movement, exercise care in placing backfill adjacent to foundation walls, retaining walls, utility lines and other structures. Backfill on opposite sides of structures at approximately the same elevation to prevent unbalanced earth pressure. During backfilling, the difference in elevation of backfill on opposite sides of the structure shall not exceed 24 inches, except as noted. Where backfill of buried wall is only on one side, only hand-operated roller or plate compactors shall be used within a lateral distance of 5 feet of back of wall for walls less than 15 feet high and within 10 feet of back of wall for walls more than 15 feet high.

D. Except as otherwise noted, tolerance of top surface of completed backfill shall be ±2 inches from true grade indicated, and variations from indicated tolerance shall approximately compensate within each 100 square feet area.

E. Compact subgrade and backfill of indicated areas or structures as specified in the following table. Allow the Owner's Geotechnical Consultant sufficient time to make necessary observations and tests. Base the degree of compaction upon a maximum dry density as determined in accordance with ASTM D-1557.

COMPACTION TABLE

Areas	Minimum Percent Compaction
1. Pavement and slab-on-grade building base courses	95%
2. Below building foundations	95%
3. Below building slab-on-grade base course	95%
4. Below pavement, walks and exterior slabs subbase, base courses and backfill for retaining walls.	92%
5. Backfill for modular block retaining walls	95%
6. Trench backfill	92%
7. Common fill within the top 2'-0" of grade in grass areas	92%
8. In grass areas below 2'-0" from grade	90%

F. Conform to the following table for minimum layer thickness, types of equipment, and minimum number of passes. These are minimum standards only and in no way relieve the Contractor of the Contractor's obligation to achieve the specified degree of compaction by whatever additional effort is necessary.

	Maximum Stone Size		Maximum Loose Lift Thickness		Minimum Number of Passes	
COMPACTION METHOD	Below Structures and Pavement	Less Critical Areas	Below Structures and Pavement	Less Critical Areas	Below Structures and Pavement	Less Critical Areas
Hand-operated vibratory plate or light roller in confined areas	4"	5"	6"	8"	4	4
Hand-operated vibratory drum rollers weighing at least 1,000# in confined areas	6"	8"	10"	12"	4	4

Light vibratory drum roller. Minimum weight at drum: 8000 lbs. Minimum dynapac force: 10,000 lbs	8"	12"	12"	18"	4	4
Medium vibratory drum roller. Minimum weight at drum: 10, 000 lbs. Minimum dynapac force: 20,000 lbs	8"	12"	18"	24"	6	6

G. Place fill in horizontal layers. Where the horizontal layer meets a rising slope, key the layer into the slope by cutting a bench into the slope during the spreading of each lift.

H. Apply compaction requirements to the material directly below the indicated supported item (base course or structure), and to all material above the undisturbed earth and enclosed by the following planes:

1. Horizontal plane at the elevation of the bottom of the supported item (base course or structure), within a perimeter line located 2 feet beyond the exterior face or edge of item.
2. Flat sloping planes extending from the perimeter line downward and outward at 45 degree angle with the horizontal, to where the planes intersect undisturbed earth. Where zones of higher and lower percentages of compaction overlap, that of the higher percentage applies.

I. Backfilling of utility trenches.

1. After pipes and joints have been inspected and approved by the Architect, carefully place and tamp bearing material in 6 inch layers around the pipe for uniform bearing.
2. Install marker tape as specified.
3. Place backfill in 6 inch lifts and compact to the required density.
4. Refer to the Sections describing utility installations for special backfill requirements.

J. Preparation of subgrade in paved areas.

1. Shape Subgrade to line, grade and cross section, and proof-compact with a minimum of 6 passes of a vibratory drum roller (with a minimum static drum weight of 10,000 pounds, capable of at least 20,000 pounds of dynamic force). Alternatively, densify existing fill subgrades where encountered in accordance with Paragraph 3.08.A. Excavate any weak or soft spots identified during proof-rolling and replace with compacted Granular Fill. Include plowing, discing, and any moistening or aerating required to obtain specified compaction.
2. Bring low areas resulting from removal of unsatisfactory material or excavation of Work up to required grade with Granular Fill, and shape the entire Subgrade to line, grade and cross section, and compact as specified.
3. After compaction the surface of the subgrade for paved areas shall not show deviation greater than 1 inch when tested with a 10 foot straightedge applied both parallel and at right angles to the centerline of the area.
4. The elevation of the finished subgrade shall not vary more than 1 inch from the established grade and cross section.

K. Base courses.

1. Base course consists of placing base material, in layers of specified thickness, over subgrade to support slabs-on-grade, sidewalks, and bituminous concrete. See other Division 32 sections for paving specifications.
2. During construction, maintain lines and grades including crown and cross-slope of base course.
3. Place shoulders along edges of base course to prevent lateral movement. Construct shoulders of gravel base material, placed in such quantity to compact to the thickness of each base course layer. Compact and roll at least a 2 foot width of shoulder simultaneously with compacting and rolling of each layer of base course.
4. Place base course material on prepared subgrade in layers of uniform thickness, conforming to indicated cross-section and thickness. Maintain optimum moisture content for compacting base material during placement operations.
5. When a compacted base course is shown to be 6 inches or less, place material in a single layer. When shown to be more than 6 inches thick, place material in equal layers, except no single layer shall be more than 6 inches or less than 3 inches in thickness when compacted.
6. The elevation of the finish base course shall not vary more than 3/4 inch under a 10 foot straightedge.

L. Do not place fill over frozen soil. Remove frozen soil prior to the placement of fill.

3.12 MOISTURE CONTROL OF FILL

A. Uniformly distribute moisture content as practicable within each lift, and adjust as necessary to obtain the specified compaction.

B. Moisture condition material which does not contain sufficient moisture to be compacted to the specified densities by methods approved by the Owner's Geotechnical Consultant.

C. Dry material containing excess moisture to a proper moisture content for compaction before placing and compacting. Remove and replace excessively moist soils or scarify by use of plows, discs, or other approved methods, and air-dry to meet the above requirements. If the fill cannot be dried within 48 hours of placement, remove and replace with drier fill.

D. Materials which are within the moisture requirements specified above, but which display pronounced elasticity or deformation under the action of earthmoving and compaction equipment, shall be reduced to Optimum Moisture Content, or below, and recompacted until stable.

E. In the event that exposed subgrades and fills become inundated remove excess water prior to placement of fills or paving activities.

F. Protect fill areas by grading to drain and providing a smooth surface that will readily shed water. Grade the surface of the areas in such a manner as to prevent ponding of surface runoff in areas to receive compacted fill.

3.13 MAINTENANCE

A. Protect newly graded areas from traffic and erosion, and keep free of trash and debris. Repair and re-establish grades in settled, eroded, and rutted areas to specified tolerances.

B. Where completed areas are disturbed by subsequent construction operations or adverse weather, scarify the surface, re-shape, and compact to required density prior to further construction.

C. Maintain ditches and drains along the subgrade so they drain effectively at all times.

D. Storage or stockpiling of materials on the finished subgrade will not be permitted.

3.14 DISPOSAL OF EXCESS AND WASTE MATERIALS

A. Legally remove waste materials including trash, debris and excess excavated materials from the property of the Owner.

B. Removal of any excavated materials containing any contaminant from the site shall be in accordance with the anti-degradation provisions of the MCP, 310 CMR 40.0032(3).

C. Dispose of all excess excavated materials at off-site locations at no additional expense to the owner.

END OF SECTION 31 20 00

SECTION 32 12 16
ASPHALT PAVING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Procurement and Contracting Requirements and Division 01 General Requirements apply to this Section.

1.02 PROVISIONS INCLUDED

A. General provisions of the Contract, including General and Supplementary Conditions and Division 01 Specifications Sections, apply to this section.

1.03 SUMMARY

A. Section Includes:
   1. Hot-mix asphalt paving including curbing.

B. Related Work Specified in Other Sections:
   1. Division 31 Section “Earth Moving”

1.04 REFERENCED STANDARDS

A. Massachusetts Highway Department (MHD), “Standard Specification for Highways and Bridges.”

B. Manual on Uniform Traffic Control Devices (MUTCD)

C. American Society of Testing and Materials, “Annual Book of ASTM Standards.”

D. American Association of State Highway and Transportation Officials (AASHTO), “Standards of the American Association of State Highway and Transportation Officials.”

1.05 SUBMITTALS

A. Truck weigh slips showing type and quantity of hot mix asphalt delivered to the site.

B. Compaction test results.

C. Product Data: For each type of product indicated. Include technical data and tested physical and performance properties.
   1. Job-Mix Designs: Certification, by authorities having jurisdiction, of approval of each job mix proposed for the Work.

D. Qualification Data: For qualified manufacturer and installer of standard pavement.

E. Material Test Reports: For each paving material.

F. Manufacturer’s cut sheet for proprietary products such as paint.

G. For recycled content, indicating postconsumer and preconsumer recycled content and cost.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: A paving-mix manufacturer registered with and approved by authorities having jurisdiction in which Project is located.

B. Testing Agency Qualifications: Qualified according to ASTM D 3666 for testing indicated.

1.07 PROJECT CONDITIONS

A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp, if rain is imminent or expected before time required for adequate cure, or if the following conditions are not met:
   1. Prime Coat: Minimum surface temperature of 60 deg F.
   2. Tack Coat: Minimum surface temperature of 60 deg F.
   3. Asphalt Binder Course: Minimum surface temperature of 50 deg F and rising at time of placement.
   4. Asphalt Wearing Course: Minimum surface temperature of 60 deg F at time of placement.

PART 2 - PRODUCTS

2.01 BITUMINOUS CONCRETE PAVEMENT

A. Bituminous concrete pavement shall be Class I bituminous concrete road pavement conforming to Section 460, Paragraph 460.40 of the M.H.D. Specifications.
   1. Bottom course: Binder course in conformance with the job mix formula given in Section M, Paragraph M3.11.03 of the M.H.D. Specifications.
   2. Wearing course: Top course in conformance with the job mix formula given in Section M, Paragraph M3.11.03 of the M.H.D. Specifications.

2.02 BITUMINOUS CONCRETE CRACK SEALER

A. Hot applied bituminous concrete crack sealer in conformance with Section M3.05.4 of the M.H.D. Specifications.

B. Tack Coat: Emulsified asphalt; ASTM D 977.

PART 3 - EXECUTION

3.01 SUBGRADE AND BASE PREPARATION, BACKFILLING AND COMPACTION

A. Subgrade and base preparation, backfilling and compaction shall be in accordance with Division 31 Section Earth Moving and the following.
   1. Loosen exceptionally hard spots and re-compact. Remove spongy and otherwise unsuitable materials and replace with stable base course material. Fill and tamp traces of utility trenches.

2. Maintain base course in satisfactory condition, protected against traffic and properly drained, until the surface improvements are placed. In areas to receive pavement, place grade stakes spaced sufficiently to afford facility for checking the subgrade levels.
3. Check and adjust elevation and position of manhole covers, grates, valve boxes and similar structures located within area to be paved.

3.02 BITUMINUOUS CONCRETE PAVEMENT

A. Install bituminous concrete pavement in accordance with Section 460, Paragraphs 460.21, 460.60, 460.61, 460.63, 460.64, 460.65, 460.66, 460.67 and 460.68 of the M.H.D. Specifications.

B. Place bituminous concrete pavement for roads and walks in two courses of thickness as shown on the drawings.

C. The surface of the bottom course shall be parallel to the grade of the finished surface.

D. The finished surface course shall conform to the grades shown on the Drawings, and shall be within the tolerances listed in Section 460, Paragraph 460.67 of the M.H.D. Specifications.

E. Between initial and final steel wheel rolling of both binder and top courses, compact pavement with a self-propelled pneumatic roller.

F. Establishment of grades, grade control and conformance to finished pavement surface grade tolerances required shall be the responsibility of the Contractor in accordance with the Drawings and Specifications.

G. The finished surface shall be free from depression exceeding ¼ inch as measured with a 10 foot straightedge.

H. A tack coat shall be installed between the bottom course and wearing course if the bottom course has been in place for more than 7 days. The bottom course shall be cleaned prior to the tack coat application.

3.03 BITUMINOUS CONCRETE BERM

A. Construct berm to the extent and shape shown on the drawings.

B. Install bituminous concrete berm in accordance with Section 501, Paragraph 501.64 of the MassDOT specifications.

C. The bituminous concrete mixture shall be placed and compacted with a machine acceptable and approved by the Architect. The machine shall be capable of spreading the mixture true to line and grade and to the shape stipulated.

D. The bituminous concrete berm shall be placed on a bituminous concrete binder course, as shown on the Drawings.

E. If at any time before the acceptance of the work, soft or imperfect spots develop in the exposed surface of the berm, such material shall be removed and replaced.

3.04 REHABILITATION OF EXISTING PAVEMENT

A. Patching of existing pavement shall be required in each of the following locations.
   1. Where new pavement abuts existing pavement.
   2. Where existing pavement is cut, damaged or removed to install work under this Contact.
   3. Where existing pavement is damaged, broken, severely cracked or removed due to Contractor's operations.

B. Patching of bituminous pavement within or adjacent to the limits of public ways shall be in accordance with the requirements of the Town of Montague Department of Public Works and the MassDOT.

C. Saw cut the edge of existing pavement in a straight line at a 45 degree angle to the vertical.

D. Remove all existing loose or cracked areas of pavement.

E. Install a base of compacted gravel fill as specified in Division 31 Section Earth Moving, under all areas to receive bituminous pavement.

F. Paint edges of existing pavement with a thin coat of bitumen, RC-70, immediately before placing new pavement.

G. Install bituminous concrete pavement as specified. Provide a smooth transition in surface where new pavement abuts existing paved surfaces.

3.05 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections. Tests shall include, but are not limited to, compaction testing, ground surface and mix temperatures, layer thicknesses, and surface smoothness.

B. Thickness: In-place compacted thickness of hot-mix asphalt courses will be determined according to ASTM D 3549.

C. Surface Smoothness: Finished surface of each hot-mix asphalt course will be tested for compliance with smoothness tolerances.

D. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

3.06 DISPOSAL

A. Except for material indicated to be recycled, remove excavated materials from Project site and legally dispose of them in an EPA-approved landfill.
   1. Do not allow milled materials to accumulate on-site.

END OF SECTION 32 12 16

SECTION 32 13 13
CONCRETE PAVING

GENERAL

1.01 PROVISIONS INCLUDED

A. 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 exterior cement concrete pavement for the following:
   1. Walkways.
   2. Equipment pads and door aprons.

B. Related Sections include the following:
   1. Division 03 Section "Cast-in-Place Concrete" for general building applications of concrete.
   2. Division 31 Section "Earth Moving" for subgrade preparation, grading, and subbase course.

1.03 SUBMITTALS

A. Product Data: For each type of manufactured material and product indicated.

B. Design Mixtures: For each concrete pavement mixture. Include alternate mixture designs when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

C. Manufacturer’s product data for joint filler and joint sealer

1.04 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced Installer who has successfully completed installations similar in material, design, and extent to that indicated for Project.

B. Single-Source Responsibility: Obtain each color, type, and variety of concrete, joint materials, and setting materials from a single source with resources to provide products and materials of consistent quality in appearance and physical properties without delaying progress of the work.

C. Field-Constructed Mockup: Prior to installation of concrete paving, erect mock-ups for each form and pattern of concrete paving required to verify selections made under sample submittals. Build mock-ups to comply with the following requirements, using materials and same base construction including special features for concrete including but not limited to; banding, alignment, colors, expansion joints and control joints with steel troweled edge, saw cut control joints, broom finish and light sand-blast finish surfaces and contiguous work as indicated for final unit of Work.

1. Locate mock-ups on site in location and size indicated or, if not indicated, as directed by Architect.

2. Notify Architect one week in advance of the dates and times when mock-ups will be erected.

3. Demonstrate quality of workmanship that will be produced in final unit of Work.

4. Obtain Architect's acceptance of mock-ups before start of final unit of Work.

5. Retain and maintain mock-ups during construction in undisturbed condition as a standard for judging completed unit of Work.

    a. When directed, demolish and remove mock-ups from Project site

1.05 PROJECT CONDITIONS

A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

PRODUCTS

2.01 BASE MATERIALS

A. Base materials shall conform to Section 31 20 00.

2.02 PORTLAND CEMENT CONCRETE

A. Portland cement concrete for pavement: Concrete, steel reinforcing, and equipment, workmanship, and materials shall conform to Section 03 30 00, except as specified.

B. Concrete:
1. Minimum compressive strength of 4000 psi at 28 days.
2. Coarse aggregate 1-1/2 inches maximum size.
3. Slump: not more than 3-1/2 inches.
4. Air content by volume of concrete, determined in accordance with ASTM C173 based on measurements made immediately after discharge from the mixer: 5 to 7 percent.

C. Welded wire fabric: W.W.F. 6 x 6 - W 1.4 x W 1.4.

2.03 ACCESSORY MATERIALS

A. Joint filler: Resin impregnated fiberboard conforming to ASTM D1752.

B. Joint sealer: ASTM D1850. Match color of concrete

2.04 FORMWORK

A. Forms shall be of wood or steel, straight, of sufficient strength to resist springing during depositing and consolidating concrete, and of a height equal to the full depth of the finished sidewalk or pad.

B. Wood forms shall be surfaced plank, 2 inch nominal thickness. Steel forms shall be of approved section with flat top surface.

EXECUTION

3.01 PORTLAND CEMENT CONCRETE PAVEMENT

A. Subgrade and base preparation, backfilling and compaction shall be in accordance with Section 31 20 00 and the following.

1. Loosen exceptionally hard spots and re-compact. Remove spongy and otherwise unsuitable materials and replace with stable base course material. Fill and tamp traces of utility trenches.

2. Maintain base course in satisfactory condition, protected against traffic and properly drained, until the surface improvement is placed. In areas to receive pavement, place grade stakes spaced sufficiently to afford facility for checking the subgrade levels. Correct irregularities, compacting fill materials.

3. Check for correct elevation and position all manhole covers, grates, valve boxes, and similar structures, located within areas to be paved or surfaced and make any necessary adjustments in such structures.

B. Form construction.

1. Set forms with the upper edge true to line and grade. Held rigidly in place by stakes placed at intervals not to exceed 4 feet.

2. Coat with form oil each time before concrete is placed. At the Contractor's option, wood forms may be thoroughly wetted with water before concrete is placed, except that with probable freezing temperatures, oiling is mandatory.

3. Side forms shall be left in place for at least 12 hours after finishing has been completed.

C. Place welded wire fabric in concrete pavement, unless bar reinforcing is specifically indicated on the Drawings.

D. Concrete placement and finishing.

1. Concrete shall be placed in the forms in one layer of such thickness that when compacted and finished the pavement will be of the thickness indicated. After the concrete has been placed in the forms, a strike-off guided by the side forms shall be used to bring the surface to the proper section to be compacted.

2. The concrete shall be tamped and consolidated with a suitable wood or metal tamping bar, and the surface shall be finished to grade with a wood float. The finished surface of the pavement shall not vary more than 3/16 inch from the testing edge of a 10 foot straightedge.

3. Construct expansion, and control joints true to line with face perpendicular to surface of concrete. Construct transverse joints at right angles to the centerline, unless otherwise indicated. Irregularities exceeding the above shall be satisfactorily corrected.

4. The surface shall be divided into rectangular areas by means of control joints and expansion joints. The surface shall be "broom" finished in one direction to provide a skid resistant finish or a light sand-blast finish to expose the aggregate and shall be provided in areas indicated on the drawings.

5. Sub-slabs shall have rough "raked" finish.

6. Control Joints: Install control joints in the fresh concrete by cutting a groove in the top portion of the slab to a depth of approximately one-fourth of the pavement slab thickness.

    a. Tooled Joints: Form weakened-plane joints in fresh concrete by grooving top portion with a recommended cutting tool and finishing edges with a jointer to provide a smooth steel trowel edge 1 1/2" to either side of the groove.

    b. Sawed Joints: Form weakened-plane joints with powered saws equipped with shatterproof abrasive or diamond-rimmed blades saw as indicated on drawings. Cut joints into hardened concrete as soon as surface will not be torn, abraded, or otherwise damaged by cutting action.

7. Expansion joints.

    a. Transverse expansion joints shall be installed at pavement returns, adjacent to foundation structures and opposite expansion joints in adjoining curbs. Where the pavement is not in contact with the curb, transverse expansion joint shall be installed at a 30 foot maximum spacing or as indicated on the Drawings.

    b. Transverse expansion joints shall be filled with 1/2 inch thick joint filler. Joint filler shall be placed with top edge 1/4 inch below the surface and shall be held in place with steel pins or other devices to prevent warping of the filler during floating and finishing.

    c. Immediately after finishing operations are completed, joint edges shall be rounded with the edging tool having a radius of 1/8 inch, a smooth steel trowel edge of 1 1/2" to either side of the joint, and concrete over the joint filler shall be removed.

    d. Expansion joints shall be formed about structures and features that project through or into the pavement, using joint filler of the type, thickness, and width indicated on the Drawings. The filler shall be installed in such manner as to form a complete uniform separation between the structure and pavement.

e. At the end of the curing period, expansion joint shall be carefully cleaned and filled with joint sealer. The concrete at the joint shall be surface dry, and the atmospheric and pavement temperatures shall be 50 degrees F, minimum, at the time of application of joint sealing materials.

f. The joints shall be filled flush with the concrete surface in such manner as to minimize spilling on the surface. Spilled sealing material shall be removed immediately and the surface cleaned.

8. Surface uniformity: The completed surface shall be uniform in color and free of surface blemishes and tool marks. Provide a light broom finish in directions as indicated on drawings.

E. Immediately after the finishing operations, the exposed concrete surface shall be cured for 7 days by mat, impervious sheet, or membrane curing method.

F. After curing, remove debris and backfill, grade and compact the area adjoining the pavement to conform to the surrounding area in accordance with the lines and grades indicated on the Drawings.

3.02 REPAIRS AND PROTECTIONS

A. Repair or replace broken or defective concrete, as directed by Architect.

B. Drill test cores where directed by Architect when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory pavement areas with portland cement concrete bonded to pavement with epoxy adhesive.

C. Protect concrete from damage until acceptance of work. Exclude traffic from pavement for at least 14 days after placement. When construction traffic is permitted, maintain pavement as clean as possible by removing surface stains and spillage of materials as they occur.

D. Sweep concrete pavement and wash free of stains, discoloration, dirt, and other foreign material just before final inspection.

END OF SECTION 32 13 13

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SECTION 32 16 00
CURBING

PART 1 - GENERAL

1.01 PROVISIONS INCLUDED

A. The general provisions of the Contract, including General and Supplementary Conditions and Division 1 - General Requirements, apply to work specified in this Section.

1.02 SUMMARY

A. This section specifies curbing of the following types:

1. Granite curbing.

B. Related Work Specified in Other Sections:

1. Division 31 Section “Earth Moving” for excavation, grading, and preparation of subgrade.
2. Division 32 Section “Asphalt Paving” for bituminous concrete pavement.
3. Division 32 Section “Concrete Paving” for portland cement concrete pavement.

1.03 REFERENCES

A. Massachusetts Department of Public Works (DPW) (State Specifications): “Standard Specifications for Highways and Bridges,” with Supplementary Specifications.

B. American Society for Testing and Materials (ASTM).

1. ASTM C150: Standard Specification for Portland Cement.
2. ASTM C173: Standard Test Methods for Air Content of Freshly Mixed Concrete by the Volumeric Method.

1.04 SUBMITTALS

A. Product Data: For curbing, joint fillers, setting bed materials, and curing compounds.

B. Shop drawings: Plans, showing layout and extent of curbing. Details showing dimensions and cross section for each different size and shape of curb unit required.

C. Test reports: 28 day concrete strength. Submit test reports for each test within 10 working days after test completion.

PART 2 - PRODUCTS

2.01 BASE AND BACKFILL MATERIALS

A. Conform to Section 31 20 00 – Earth Moving.

2.02 GRANITE CURBING

A. Vertical Granite Curbing: Conform to Division III, Section M9, Paragraphs M9.04.0 and M9.04.01 of the State Specifications for Type VA4, finished as follows:

1. Top surface: Saw cut to true planes.
2. Front Face: Smooth quarry split.

B. Curb Corners: Vertical granite curb corners conforming to Division III, Section M9, Paragraph M9.04.06 of the State Specifications.

C. For radii less than 100 feet, provide curved radius sections. For radii greater than 100 feet provide straight curb sections less than 6 feet in length.

2.03 MORTAR AND MISCELLANOUS ACCESSORIES

A. Mortar mix for pointing joints in curbing: Equal parts cement and sand with sufficient water to form a workable mixture.

B. Joint Filler: AASHTO M153.

PART 3 - EXECUTION

3.01 SUBGRADE AND BASE PREPARATION

A. In accordance with Section 31 20 00.

3.02 INSTALLATION OF CURBS

A. Set to the required line and grade.

C. Set curb items in a trench which has been excavated to a width as shown on the Drawings, and to a subgrade depth 6 inches below the bottom edge of the granite.

D. Backfill trench to required level to support vertical granite items at final grade, and compact the backfill.

E. Butt curbing sections, leaving 1/8 inch to 3/4 inch joints

F. Fill vertical joints with mortar. Point exposed joints. Clean excess mortar from the face of the stone.

END OF SECTION 32 16 00

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SECTION 32 17 23
PAVEMENT MARKINGS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Procurement and Contracting Requirements and Division 01 General Requirements apply to this Section.

1.02 SUMMARY

A. This Section includes the following:
   1. Installation of white reflectorized thermoplastic pavement markings for crosswalks, stop lines and linear roadway surface markings.
   2. Installation of fast drying, water-based traffic paint for parking stall lines on conventional pavement.

B. Related Work Specified in Other Sections:
   1. Division 01 Section “Construction Phasing”
   2. Division 32 “Asphalt Paving”

1.03 REFERENCED STANDARDS

A. Massachusetts Department of Transportation (MassDOT), “Standard Specification for Highways and Bridges.”

B. 2009 Manual on Uniform Traffic Control Devices with all more recent amendments.

1.04 SUBMITTALS

A. Product Data

B. LEED Submittals: N/A
   1. Complete “Sustainable Materials Attributes Submittal Form” attached to Section 01 81 13 “Sustainable Design Requirements.”
   2. Provide supporting documentation, as required in Section 01 81 13, from manufacturer for materials attributes data submitted.

1.05 QUALITY ASSURANCE

A. All work under this Section shall conform to the latest edition of each of the Referenced Standards as noted above including:
   1. Section 860 Reflectorized Pavement Markings, and Materials Sections M7.00.00, M7.01.03, M7.01.04 and M7.01.07 of the MassDOT Standard Specifications.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver pavement marking materials to Project site in original packages with seals unbroken and bearing manufacturer's labels containing brand name and type of material, date of manufacture, and directions for storage.

B. Store pavement marking materials in a clean, dry, protected location within temperature range required by manufacturer. Protect stored materials from direct sunlight.

1.07 PROJECT CONDITIONS

A. Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 45 deg F for oil-based materials, 55 deg F for water-based materials, and not exceeding 95 deg F.

PART 2 - PRODUCTS

2.01 REFLECTORIZED THERMOPLASTIC PAVEMENT MARKINGS

A. Products shall be listed on MassDOT's Qualified Construction Material List.

B. Reflectorized Thermoplastic Pavement Markings shall conform to Section 860 of the MassDOT Standard Specifications.
1. M700.00, General requirements for paints and protective coatings.
2. M7.01.03, White Thermoplastic Reflectorized Pavement Markings.
3. M7.01.04, Yellow Thermoplastic Reflectorized Pavement Markings
4. M7.01.07, Glass Beads

2.02 CONVENTIONAL PAVEMENT MARKING PAINT

A. Pavement-Marking Paint: Alkyd-resin type, lead and chromate free, ready mixed, complying with AASHTO M 248, Type N; colors complying with FS TT-P-1952.
1. Color: White, Yellow.

B. Glass Beads: AASHTO M 247, Type 1

PART 3 - EXECUTION

3.01 REMOVAL

A. Removal of existing pavement markings: N/A
1. The Contractor shall remove the existing conflicting markings by a method that is not injurious to the roadway surface and is acceptable to the Engineer.

3.02 INSTALLATION

A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Architect.

B. Allow paving to age for a minimum of 7 days before starting pavement marking.

C. Sweep and clean surface to eliminate loose material and dust.

D. Apply paint with mechanical equipment to produce pavement markings, of dimensions indicated, with uniform, straight edges. Apply conventional pavement marking paint at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils in two layers. Apply an additional 2 layers 30 to 60 days after the initial 2 layers are applied.

E. Apply in accordance with Section 860, Paragraphs 860.60, 860.61, 860.63 and 860.64 of the MassDOT Standard Specifications.

F. Material application temperature: 400° F to 425° F.

G. Thermoplastic line thickness: 125 to 188 mils. Line width: As indicated on the drawings.

H. Reflectorized Bead Application: 1 pound per 10 Square Feet Drop on.

I. Thinners shall not be used for pavement marking application except in accordance with the manufacturer’s recommendations.

J. Install reflectorized traffic markings in straight and true lines.

K. Colors: Crosswalk and Stop lines shall be white and shall be 18 inches wide with length and spacing as shown on the Drawings. Stall lines and edge lines shall be white and shall be 4 inches wide with length and spacing as shown on the Drawings. Other lines shall be of color and thickness as shown on the Drawings.

END OF SECTION 32 17 23

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SECTION 32 92 00
TURF AND GRASSES

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. Provide all labor, materials, equipment, services, and perform all operations necessary to complete the work of this section as indicated within the drawings and specified herein which shall include, but is not limited to, the following:
   1. Seeding.
   2. Sodding.
   3. Planting soils.
   4. Soil amendments.
   5. Erosion control material.
   6. Maintenance.

B. Related Sections:
   1. Division 31 Section "Site Clearing" for topsoil stripping and stockpiling.
   2. Division 31 Section "Earth Moving" for excavation, filling and backfilling, and rough grading.
   3. Division 32 Section "Plants" for installation and coordination.

1.03 DEFINITIONS

A. Finish Grade: Elevation of finished surface of planting soil for seeding and surface of thatch for sod.

B. Manufactured Topsoil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.

C. Planting Soil or Loam: Standardized topsoil; existing, native surface topsoil; existing, in-place surface soil; imported topsoil; or manufactured topsoil that is modified with soil amendments and fertilizers to produce a soil mixture best for plant growth.

1.04 SUBMITTALS

A. Product Data: Submit manufacturer's published product data including product specifications, installation instructions, test data and other pertinent technical data for the following prior to ordering items:
   1. Erosion control material.

B. Topsoil Test Reports:

1. For imported or manufactured topsoil.

C. Qualification Data: For qualified landscape Installer.

D. Certification of Grass Seed: From seed vendor for each grass-seed monostand or mixture stating the botanical and common name, percentage by weight of each species and variety, and percentage of purity, germination, and weed seed. Include the year of production and date of packaging.

E. Certification of each seed mixture for turfgrass sod: Include identification of source and name and telephone number of supplier.

F. Product Certificates: For soil amendments and fertilizers, from manufacturer.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: A single qualified landscape Installer specializing in this work and employing only experienced workers, familiar with planting procedures, and under the full time supervision of a qualified supervisor. The Contractor must show previous evidence of having successfully installed and maintained landscape projects of similar scope with regards to quantity and complexity whose work has resulted in successful turf.
1. Professional Membership: Installer shall be a member in good standing of either the Professional Landcare Network or the American Nursery and Landscape Association.
2. Experience: Five years' minimum experience in turf installation in addition to requirements in Division 01 Section "Quality Requirements."
3. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.

B. Soil-Testing Laboratory Qualifications: An independent laboratory or university laboratory, recognized by the State Department of Agriculture, with the experience and capability to conduct the testing indicated and that specializes in types of tests to be performed.

C. Topsoil Testing and Analysis: The Contractor shall submit representative samples of topsoil to a soil testing laboratory for testing and analysis, in conformance with the Standards of the Association of Official Agricultural Chemicals and the USDA Textural Classification and have testing report sent directly to the Architect.
1. Provide 5 separate samples from each individual off site loam source.
    a. Each sample submitted shall be a minimum of 1 quart in quantity.
2. Soil test report that shall include;
    a. Mechanical sieve analysis with soil classification.
    b. Organic content.
    c. Chemical analysis which shall include: pH (1:1 soil-water ratio), buffer pH, Soluble Salts (1:2 soil-water ratio), Nitrate Nitrogen, Ammonium Nitrogen, Phosphorus, Potassium, Calcium, Aluminum, Magnesium, Manganese, Ferric Iron, Sulfate and toxins including but not limited to lead, cadmium, arsenic, and mercury.
    d. Inform the Soil Testing Laboratory that soil tests are for specific applications, i.e.; tree and shrub plantings, turfgrass, wetland restoration and retention areas.
3. Test and analysis reports shall include the laboratory’s recommendations for amending the topsoil, if necessary, to meet these Specifications herein for each planting area.

4. Obtain written approval from the Architect before delivering materials to the site. Do not use topsoil until test results have been received by the Architect and amendments per specifications and laboratory recommendations required have been completed.

D. The Architect reserves the right to request topsoil testing and analyses (up to 10 additional tests) after the material have been placed on site, during the maintenance period or during the guarantee period. All testing shall be paid by the Contractor at no additional cost to the Owner.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Seed and Other Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of conformance with state and federal laws, as applicable.

B. Sod: Harvest, deliver, store, and handle sod according to requirements in "Specifications for Turfgrass Sod Materials" and "Specifications for Turfgrass Sod Transplanting and Installation" in TPI's "Guideline Specifications to Turfgrass Sodding." Deliver sod in time for planting within 24 hours of harvesting. Protect sod from breakage and drying.

1.07 PROJECT CONDITIONS

A. Seeding Restrictions: Complete seed operations during one of the following periods. Coordinate seeding periods with maintenance periods to provide required maintenance.
1. Spring Seeding: April 15 through June 15.
2. Fall Seeding: August 15 through October 15.

B. Sodding Restrictions: Complete sodding operations during one of the following periods. Coordinate sodding periods with maintenance periods to provide required maintenance.
1. Spring Sodding: April 15 through June 15.
2. Fall Sodding: August 15 through October 31.

C. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions.

1.08 MAINTENANCE SERVICE

A. Turf Maintenance: Provide full maintenance by skilled employees of landscape Installer. Maintain as required in Part 3. Begin maintenance immediately after each area is planted and continue until acceptable turf is established but for not less than the following periods:
1. Seeded Turf: 90 days from date of completion of seeding operations:
   a. Seeding operations completed between September 1 through September 15 will continue maintenance during next planting season until April 30.
   b. Seeding operations completed between September 16 through September 30 will continue maintenance during next planting season until May 15.
   c. Seeding operations completed by October 1 through April 15 will continue maintenance during next planting season until June 30.
2. Sodded Turf: 90 days from date of completion of sodding operations.

a. Sod installation operations completed between September 16 through September 30 will continue maintenance during next planting season until April 15.
b. Sod installation operations completed by October 1 through April 15 will continue maintenance during next planting season until June 30.

B. Notify the Architect in writing upon the completion of the installation of the seeding and sodding operations, the beginning date of the maintenance period and the anticipated completion date of the maintenance period.

PART 2 - PRODUCTS

2.01 PLANTING SOILS

A. Topsoil: Topsoil shall be natural, fertile, friable soil, without admixture of subsoil, clean and reasonably free from clay, lumps, stones, stumps, roots or similar materials and free from debris or other objects which might be a hindrance to planting operations, and as follows:
1. Obtain off-site topsoil from local sources and are from naturally, well drained sites where topsoil occurs at a depth of not less than 4 inches.
2. Texture: Topsoil shall be a "sandy loam" as determined by mechanical analysis and based on the "USDA Textural Classification" and it shall conform to the following grain size distribution:
a. Percent passing by weight:

U.S. Standard Sieve	Minimum	Maximum
½"	100	
#10	81	93
#18	66	87
#35	52	82
#60	35	66
#140	12	34
#300	5	18
Silt	4	13
Clay	1	5

1. pH value: Portion of the sample that passes a ¼ inch sieve shall fall within a range of pH 5.5 to pH 7.0.
2. Organic Matter: General seeded areas.
a. Portion of the sample which passes ¼ inch sieve shall contain not less than 5 percent nor more than 7 percent organic matter, as determined by the wet combustion method on a sample directed at 105°C.
b. To adjust organic matter content, the soil may be amended, prior to site delivery, by the addition of composted humus. Use of organic amendments is acceptable only if random soil sampling indicates thorough incorporation.

2.02 SEED

A. Grass Seed: Fresh, clean, dry, new-crop seed complying with AOSA's "Journal of Seed Technology; Rules for Testing Seeds" for purity and germination tolerances.

B. Lawn Seed Mix: State-certified seed of grass species as follows:

Seed Variety	Proportion by Weight	Germination Minimum	Purity Minimum
Tall Fescue (Minimum 3 varieties)	70%	90%	90%
Perennial Rye (Minimum 2 varieties)	20%	90%	90%
Kentucky Bluegrass	10%	90%	95%

1. Seed mixture shall be applied at the rate of 5 pounds per 1,000 square feet.

2.03 SOD

A. Turfgrass Sod: Complying with "Specifications for Turfgrass Sod Materials" in TPI's "Guideline Specifications to Turfgrass Sodding." Furnish viable sod of uniform density, color, and texture, strongly rooted, and capable of vigorous growth and development when planted.

1. Turfgrass Sod for “Irrigated Areas”

Type of Grass	Percentage of Total Mixture
Kentucky Bluegrass (Minimum 4 varieties)	80%
Perennial Rye (Minimum 2 varieties)	20%

2. Sod for “Non Irrigated Areas”

Type of Grass	Percentage of Total Mixture
Tall Fescue (Minimum 3 varieties)	70%
Kentucky Bluegrass (Minimum 2 varieties)	20%
Perennial Rye (Minimum 2 varieties)	10%

B. Sod shall be machine cut at a uniform soil thickness of ¾ inch, plus or minus ¼ inch, at the time of cutting. Measurement for thickness shall exclude top growth and thatch. Individual pieces of sod shall be cut to the supplier’s standard width and length. Maximum allowable deviation from standard widths and lengths shall be 5%. Broken pads and torn or uneven ends will not be acceptable. Sod shall be at least 2 years old from time of original seeding. Take sod from approved sources where the soil is of such character that the sod will not break or crumble during cutting, transportation, or laying.

C. Sod shall be harvested, delivered and installed within a period of 24 hours. Sod not transplanted within this period shall be inspected and approved by the Architect prior to its installation. Soil on sod pads shall be kept moist at all times.

2.04 INORGANIC SOIL AMENDMENTS

A. Lime: ASTM C 602, agricultural liming material containing a minimum of 80 percent calcium carbonate equivalent and as follows:
1. Class: T, with a minimum of 99 percent passing through No. 8 sieve and a minimum of 75 percent passing through No. 60 sieve.
2. Provide lime in form of ground dolomitic limestone.

B. Aluminum Sulfate: Commercial grade, unadulterated.

C. Agricultural Gypsum: Minimum 90 percent calcium sulfate, finely ground with 90 percent passing through No. 50 sieve.

D. Sand: Clean, washed, natural or manufactured, and free of toxic materials.

2.05 ORGANIC SOIL AMENDMENTS

A. Compost: Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through 1/2-inch sieve; soluble salt content of 5 to 10 decisiemens/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:
1. Organic Matter Content: 50 to 60 percent of dry weight.

B. Sphagnum Peat: Humus or Peat Moss shall be natural humus, reed peat or sedge peat, finely divided peat, decomposed and free of fibers with a minimum 60 per cent Sphagnum composition by volume. pH range approximately 5.5 pH to 7.5 pH and the organic matter shall be not less than 85% as determined by loss on ignition. The minimum water absorbing ability shall be 200% by weight on an oven-dry basis.

C. Muck Peat: Partially decomposed moss peat, native peat, or reed-sedge peat, finely divided or of granular texture, with a pH range of 6 to 7.5, and having a water-absorbing capacity of 1100 to 2000 percent.

D. Manure: Well-rotted, unleached, stable or cattle manure containing not more than 25 percent by volume of straw, sawdust, or other bedding materials; free of toxic substances, stones, sticks, soil, weed seed, and material harmful to plant growth.

2.06 FERTILIZERS

A. Bonemeal: Commercial, raw or steamed, finely ground; a minimum of 4 percent nitrogen and 20 percent phosphoric acid.

B. Superphosphate: Commercial, phosphate mixture, soluble; a minimum of 20 percent available phosphoric acid.

C. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:

D. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:
1. Composition: 20 percent nitrogen, 10 percent phosphorous, and 10 percent potassium, by weight.
2. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.

2.07 MULCHES

A. Straw Mulch: Provide air-dry, clean, mildew- and seed-free, salt hay or threshed straw of wheat, rye, oats, or barley.

B. Compost Mulch: Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through 1-inch sieve; soluble salt content of 2 to 5 decisiemens/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:
   1. Organic Matter Content: 50 to 60 percent of dry weight.

C. Fiber Mulch: Biodegradable, dyed-wood, cellulose-fiber mulch; nontoxic and free of plant-growth or germination inhibitors; with a maximum moisture content of 15 percent and a pH range of 4.5 to 6.5.

D. Nonasphaltic Tackifier: Colloidal tackifier recommended by fiber-mulch manufacturer for slurry application; nontoxic and free of plant-growth or germination inhibitors.

E. Asphalt Emulsion: ASTM D 977, Grade SS-1; nontoxic and free of plant-growth or germination inhibitors.

2.08 EROSION CONTROL MATERIALS

A. Erosion Control General:
   1. Straw/Coconut Fiber Erosion Control Blankets: Layer of straw (0.35 pounds per square yard) and coconut fibers (0.15 pounds per square yard) sewn with cotton biodegradable thread between two UV-stabilized nets. North American Green SC 150 or approved equal.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas to be planted for compliance with requirements and other conditions affecting performance.
   1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
   2. Do not mix or place soils and soil amendments in frozen, wet, or muddy conditions.
   3. Suspend soil spreading, grading, and tilling operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
   4. Uniformly moisten excessively dry soil that is not workable and which is too dusty.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

C. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Architect and replace with new planting soil.

3.02 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities, trees, shrubs, and plantings from damage caused by planting operations.

1. Protect adjacent and adjoining areas from hydroseeding and hydromulching overspray.
2. Protect grade stakes set by others until directed to remove them.

B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

3.03 TURF AREA PREPARATION

A. Newly Graded Subgrades: Loosen subgrade to a minimum depth of 14 inches. Remove stones larger than 1 inch in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.
1. Spread planting soil in 2 lifts for a total minimum depth of 8 inches but not less than required to meet finish grades after light rolling and natural settlement. Do not spread if planting soil or subgrade is frozen, muddy, or excessively wet.
a. Spread approximately 1/2 the thickness of planting soil over loosened subgrade. Mix thoroughly into top 4 inches of subgrade. Spread remainder of planting soil.
b. Reduce elevation of planting soil to allow for soil thickness of sod.

B. Unchanged Subgrades: If turf is to be planted in areas unaltered or undisturbed by excavating, grading, or surface-soil stripping operations, prepare surface soil as follows:
1. Remove existing grass, vegetation, and turf. Do not mix into surface soil.
2. Loosen surface soil to a depth of at least 8 inches. Apply soil amendments and fertilizers according to planting soil mix proportions and mix thoroughly into top 4 inches of soil. Till soil to a homogeneous mixture of fine texture.
a. Apply superphosphate fertilizer directly to surface soil before loosening.
3. Remove stones larger than 1 inch in any dimension and sticks, roots, trash, and other extraneous matter.
4. Legally dispose of waste material, including grass, vegetation, and turf, off Owner's property.

C. Finish Grading: Grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture. Grade to within plus or minus 1/2 inch of finish elevation. Roll and rake, remove ridges, and fill depressions to meet finish grades. Limit finish grading to areas that can be planted in the immediate future.

D. Moisten prepared area before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

E. Before planting, obtain Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

3.04 INCORPORATION OF SAND

A. Sand shall be spread and thoroughly incorporated into the layer of loam by harrowing or other methods approved by the Architect.
1. Provide 2 cubic yard per 1,000 square feet.

3.05 INCORPORATION OF ADDITIVES

A. Soil additives shall be spread and thoroughly incorporated into the layer of loam by harrowing or other methods approved by the Architect. The following soil additives shall be incorporated.
   1. Compost: 1 cubic yard per 1,000 square feet.
   2. Ground limestone as required by soil analysis to achieve a pH of 6.0 to 6.5, with a minimum application of 60 pounds per 1,000 square feet and a maximum application of 100 pounds per 1,000 square feet per season
   3. Fertilizer as required by soil analysis with a minimum application of 20 pounds per 1,000 square feet of 10-10-10
   4. Superphosphate at the rate of 20 pounds per 1,000 square feet.

3.06 EROSION CONTROL MATERIAL INSTALLATION

A. Erosion Control Fabrics: Install erosion control fabrics which have been seeded in swales and in areas indicated within the Drawings.
   1. Install erosion control fabricate in accordance with manufacturer's instructions. Use at least 2 staples, pins or stakes per square yard. Overlap edges at 9 inches minimum.

3.07 SEEDING

A. Sow seed with spreader or seeding machine. Do not broadcast or drop seed when wind velocity exceeds 5 mph. Evenly distribute seed by sowing equal quantities in two directions at right angles to each other.
   1. Do not use wet seed or seed that is moldy or otherwise damaged.
   2. Do not seed against existing trees. Limit extent of seed to outside edge of planting saucer.

B. Sow seed at a total rate of indicated in Paragraph 2.02 "Seed".

C. Rake seed lightly into top 1/8 inch of soil, roll lightly, and water with fine spray.

D. Protect seeded areas with slopes exceeding 1:4 with erosion-control blankets and 1:6 with erosion-control fiber mesh installed and stapled according to manufacturer's written instructions.

E. Protect seeded areas with erosion-control mats where shown on Drawings; install and anchor according to manufacturer's written instructions.

F. Protect seeded areas with slopes not exceeding 1:6 by spreading straw mulch. Spread uniformly at a minimum rate of 2 tons/acre to form a continuous blanket 1-1/2 inches in loose thickness over seeded areas. Spread by hand, blower, or other suitable equipment.
   1. Bond straw mulch by spraying with asphalt emulsion at a rate of 10 to 13 gal. /1000 sq. ft. Take precautions to prevent damage or staining of structures or other plantings adjacent to mulched areas. Immediately clean damaged or stained areas.

3.08 HYDROSEEDING

A. Hydroseeding: Mix specified seed, fertilizer, and fiber mulch in water, using equipment specifically designed for hydroseed application. Continue mixing until uniformly blended into homogeneous slurry suitable for hydraulic application.
   1. Mix slurry with nonasphaltic tackifier.
   2. Apply slurry uniformly to all areas to be seeded in a one-step process. Apply slurry at a rate so that mulch component is deposited at not less than 1500-lb/acre dry weight, and seed component is deposited at not less than the specified seed-sowing rate.

3.09 SODDING

A. Lay sod within 24 hours of harvesting. Do not lay sod if dormant or if ground is frozen or muddy.

B. Lay sod to form a solid mass with tightly fitted joints. Butt ends and sides of sod; do not stretch or overlap. Stagger sod strips or pads to offset joints in adjacent courses. Avoid damage to subgrade or sod during installation. Tamp and roll lightly to ensure contact with subgrade, eliminate air pockets, and form a smooth surface. Work sifted soil or fine sand into minor cracks between pieces of sod; remove excess to avoid smothering sod and adjacent grass.
   1. Lay sod across angle of slopes exceeding 1:3.
   2. Anchor sod on slopes exceeding 1:6 with staples spaced as recommended by sod manufacturer but not less than 4 staples per sod strip to prevent slippage.

C. Saturate sod with fine water spray within two hours of planting. During first week after planting, water daily or more frequently as necessary to maintain moist soil to a minimum depth of 1 ½”below sod.

3.10 TURF MAINTENANCE

A. Maintain and establish turf by watering, fertilizing, weeding, mowing, trimming, replanting, and performing other operations as required to establish healthy, viable turf. Roll, regrade, and replant bare or eroded areas and remulch to produce a uniformly smooth turf. Provide materials and installation the same as those used in the original installation.
   1. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace materials and turf damaged or lost in areas of subsidence.
   2. In areas where mulch has been disturbed by wind or maintenance operations, add new mulch and anchor as required to prevent displacement.

B. Watering: Install and maintain temporary piping, hoses, and turf-watering equipment to convey water from sources and to keep turf uniformly moist to a depth of 4 inches.
   1. Schedule watering to prevent wilting, puddling, erosion, and displacement of seed or mulch. Lay out temporary watering system to avoid walking over muddy or newly planted areas.
   2. Water turf with fine spray at a minimum rate of 1 inch per week unless rainfall precipitation is adequate.

C. Mow turf as soon as top growth is tall enough to cut. Repeat mowing to maintain specified height without cutting more than 1/3 of grass height. Remove no more than 1/3 of grass-leaf growth in initial or subsequent mowings. Do not delay mowing until grass blades bend over

and become matted. Do not mow when grass is wet. Schedule initial and subsequent mowings to maintain the following grass height:

1. The first mowing shall not be attempted until the grass height has reached a minimum of 3 inches or as directed by the Architect. Turf height shall be maintained at 2-1/2 inch height unless otherwise specified. Thereafter grass shall be mowed at least once a week until written acceptance by the Architect

D. Turf Post fertilization: Apply fertilizer after initial mowing and when grass is dry.
   1. Use fertilizer that will provide actual nitrogen of at least 1 lb/1000 sq. ft. to turf area.

E. Liming: : If more than one initial application of limestone is required by the soils analysis to bring the pH of the stockpiled topsoil/loam borrow to a specified range, the Contractor shall be responsible for all additional required lime applications

F. Protection:
   1. Protect sod areas from trespassing and damage of any kind by the use of temporary fences. Repair any damage including those resulting from erosion and washouts. Replant bare spots with the specified sod. Secure orange flagging to the temporary fencing/barriers
   2. Barriers shall be raised immediately after sodding operations and shall be maintained until acceptance.

3.11 SATISFACTORY TURF

A. Turf installations shall meet the following criteria as determined by Architect:
   1. Satisfactory Seeded Turf: At end of maintenance period, a healthy, uniform, close stand of grass has been established, free of weeds and surface irregularities, with coverage exceeding 95 percent over any 10 square feet and bare spots not exceeding 5 by 5 inches.

3.12 CLEANUP AND PROTECTION

A. Promptly remove soil and debris created by turf work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.

B. Erect temporary fencing or barricades and warning signs as required to protect newly planted areas from traffic. Maintain fencing and barricades throughout initial maintenance period and remove after plantings are established.

C. Remove nondegradable erosion-control measures after grass establishment period.

END OF SECTION 32 92 00

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SECTION 32 93 00
PLANTS

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. Provide all labor, materials, equipment, services, and perform all operations necessary to complete the work of this section as indicated within the drawings and specified herein which shall include, but is not limited to, the following:
   1. Selection, procurement and planting of all plant materials indicated within the Drawings including:
      a. Trees.
      b. Shrubs.
   2. Planting soils.
   3. Soil amendments.
   4. Maintenance.
   5. Warranty.

B. Related Sections:
   1. Division 31 Section "Site Clearing" for topsoil stripping and stockpiling.
   2. Division 31 Section "Earth Moving" for excavation, filling, and rough grading.
   3. Division 32 Section "Turf and Grasses" for turf.

1.03 REFERENCES

A. American Association of Nurserymen (AAN): ANSI Z 260.1 “American Standard for Nursery Stock.”

B. Bailey Hortorium of Cornell University, Hortus Third, A Concise Dictionary of Plants Cultivated in the United States and Canada (for nomenclature).

C. American National Standards Association and National Arborist Association, Inc.: ANSI/ANAA A300 “Tree, Shrub and Other Woody Plant Maintenance - Standard Practices.”

1.04 DEFINITIONS

A. Backfill: The earth used to replace or the act of replacing earth in an excavation.

B. Balled and Burlapped Stock: Plants dug with firm, natural balls of earth in which they were grown, with ball size not less than diameter and depth recommended by ANSI Z60.1 for type and size of plant required; wrapped with burlap, tied, rigidly supported, and drum laced with twine with the root flare visible at the surface of the ball as recommended by ANSI Z60.1.

C. Container-Grown Stock: Healthy, vigorous, well-rooted plants grown in a container, with a well-established root system reaching sides of container and maintaining a firm ball when removed from container. Container shall be rigid enough to hold ball shape and protect root mass during shipping and be sized according to ANSI Z60.1 for type and size of plant required.

D. Finish Grade: Elevation of finished surface of planting soil.

E. Planting Soil: Standardized topsoil; existing, native surface topsoil; existing, in-place surface soil; imported topsoil; or manufactured topsoil that is modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.

F. Root Flare: Also called "trunk flare." The area at the base of the plant's stem or trunk where the stem or trunk broadens to form roots; the area of transition between the root system and the stem or trunk.

G. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

1.05 SUBMITTALS

A. Topsoil Test Reports:
1. For imported or manufactured topsoil.

B. Qualification Data: For qualified landscape Installer. Include list of similar projects completed by Installer demonstrating Installer's capabilities and experience. Include project names, addresses, and year completed, and include names and addresses of owners' contact persons.

C. Product Certificates: For each type of manufactured product, from manufacturer, and complying with the following:
1. Manufacturer's certified analysis of standard products.
2. Analysis of other materials by a recognized laboratory made according to methods established by the Association of Official Analytical Chemists, where applicable.

D. Product Data: For each type of product indicated to be installed:
1. Fertilizers
2. Inorganic soil amendments
3. Organic soil amendments
4. Anti-dessicant.

E. Maintenance Instructions: Recommended procedures to be established by Owner for maintenance of plants during a calendar year. Submit before start of required maintenance periods.

F. Submit samples of the following materials for approval by the Architect prior to ordering or delivering those items to the site:
1. Bark Mulch: 1 quart bag with label indicating source of supply.

G. Planting Schedule: Provide proposed planting schedule, indicating dates for each type of landscape work to be completed, maintenance periods and anticipated “Substantial Completion” date.

H. Warranty: Sample of warranty.

1.06 QUALITY ASSURANCE

A. Installer Qualifications: A single qualified landscape Installer specializing in this work and employing only experienced workers, familiar with planting procedures, and under the full time supervision of a qualified supervisor. The Contractor must show previous evidence of having successfully installed and maintained landscape projects of similar scope with regards to quantities and sizes of plants.
   1. Professional Membership: Installer shall be a member in good standing of either the Professional Landcare Network or the American Nursery and Landscape Association.
   2. Experience: Five years' minimum experience in plant installation in addition to requirements in Division 01 Section "Quality Requirements."
   3. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.

B. Soil-Testing Laboratory Qualifications: An independent laboratory or university laboratory, recognized by the State Department of Agriculture, with the experience and capability to conduct the testing indicated and that specializes in types of tests to be performed.

C. Topsoil Testing and Analysis: The Contractor shall submit representative samples of topsoil to a soil testing laboratory for testing and analysis, in conformance with the Standards of the Association of Official Agricultural Chemicals and the USDA Textural Classification and have testing report sent directly to the Architect.
   1. Provide 5 separate samples from each individual off site loam source.
      a. Each sample submitted shall be a minimum of 1 quart in quantity.
   2. Each soil test report that shall include;
      a. Mechanical sieve analysis with soil classification.
      b. Organic content.
      c. Chemical analysis which shall include: pH (1:1 soil-water ratio), buffer pH, Soluble Salts (1:2 soil-water ratio), Nitrate Nitrogen, Ammonium Nitrogen, Phosphorus, Potassium, Calcium, Aluminum, Magnesium, Manganese, Ferric Iron, Sulfate and toxins including but not limited to lead, cadmium, arsenic, and mercury.
   3. Test and analysis reports shall include the laboratory’s recommendations for amending the topsoil, if necessary, to meet these Specifications herein for each planting area.

D. Obtain written approval from the Architect before delivering materials to the site. Do not use topsoil until test results have been received by the Architect and amendments per specifications and laboratory recommendations required have been completed.
   1. Report shall be submitted at least 1 month before any material is to be delivered or installed on the project site.

E. The Architect reserves the right to request topsoil testing and analyses (up to 10 additional tests) after the material have been placed on site, during the maintenance period or during the guarantee period. All testing shall be paid by the Contractor at no additional cost to the Owner.

F. Measurements: Measure according to ANSI Z60.1. Do not prune to obtain required sizes.
   1. Trees and Shrubs: Measure with branches and trunks or canes in their normal position. Take height measurements from or near the top of the root flare for field-grown stock and

container grown stock. Measure main body of tree or shrub for height and spread; do not measure branches or roots tip to tip. Take caliper measurements 6 inches above the root flare for trees up to 4-inch caliper size, and 12 inches above the root flare for larger sizes.

2. Other Plants: Measure with stems, petioles, and foliage in their normal position.

G. Substitutions: No substitutions shall be made by the Contractor. If the specified plant material is not obtainable, submit proof of non-availability to the Architect, together with proposal for use of equivalent material, a minimum of one (1) month prior to installation.

H. Pre installation Conference:

1. At least 10 days in advance of the first day of planting operation arrange for a pre-construction meeting between the Architect, Owners Representative, General Contractor and Planting Subcontractor to discuss the proposed planting schedule, source of plants, consideration of proposed substitutions and general review of procedures.

1.07 QUALITY CONTROL AT THE SOURCE OF SUPPLY

A. The Architect shall have the right to inspect and select all plant materials at the source of supply for compliance with requirements for genus, species, variety, size, and quality. The Architect further retains the right to inspect trees and shrubs for size and condition of root balls and root systems, insects, injuries and latent defects, and to reject unsatisfactory or defective material at any time during progress of work.

1. Plant selection at the source does not affect the Architect's right of re-inspection and rejection of plant material during the progress of the work.

B. Make pre-selection arrangements at the source to insure a ready supply of materials, equipment, and manpower required for an efficient selection procedure. The Contractor shall pay all Architects' expenses for all visits to the source beyond a 100 mile radius from the Architects office.

1. Notify the Architect 10 days prior to the scheduled date for plant selection.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of conformance with state and federal laws if applicable.

B. Bulk Materials:

1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
2. Provide erosion-control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.

C. Do not prune trees and shrubs before delivery. Protect bark, branches, and root systems from sun scald, drying, wind burn, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy their natural shape. Provide protective covering of plants during shipping and delivery. Do not drop plants during delivery and handling.

D. Handle planting stock by root ball.

E. Deliver plants after preparations for planting have been completed, and install immediately. If planting is delayed more than six hours after delivery, set plants and trees in their appropriate aspect (sun, filtered sun, or shade), protect from weather and mechanical damage, and keep roots moist.
   1. Set balled stock on ground and cover ball with soil, peat moss, sawdust, or other acceptable material.
   2. Do not remove container-grown stock from containers before time of planting.
   3. Water root systems of plants stored on-site deeply and thoroughly with a fine-mist spray. Water as often as necessary to maintain root systems in a moist, but not overly-wet condition.

1.09 PROJECT CONDITIONS

A. The Contractor shall be solely responsible for judging the full extent of work requirements involved, including but not limited to the potential need for storing and maintaining plants temporarily and/or re-handling plants prior to final installation.

B. Field Measurements: Verify actual grade elevations, service and utility locations, irrigation system components, and dimensions of plantings and construction contiguous with new plantings by field measurements before proceeding with planting work.

C. Utilities: Verify all public and private utility locations and elevations prior to excavation.

D. Planting Restrictions: Plant during one of the following periods. Coordinate planting periods with maintenance periods to provide required maintenance from date of Substantial Completion.

1.	Spring Planting:	Deciduous material:	April 1 through June 15.
		Evergreen material:	April 1 through June 15.
2.	Fall Planting:	Deciduous material:	September 1 through November 30.
		Evergreen material:	September 1 through November 15.

E. Variance: If special conditions exist which may warrant a variance in the above planting dates, a written request shall be submitted to the Architect stating the special conditions for the proposed variance. Permission for the variance will be given if warranted in the opinion of the Architect.

F. Schedule tree selection and digging operations so as to comply with nursery industry recognition of “Spring Dig Only” or “Fall Hazard” plant materials. No substitutions of plant materials will be allowed for fall planting based on unavailability due to the “Spring Dig Only” or “Fall Hazard” restrictions. Contractor shall have selected and had the material dug during the previous spring.

G. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions and warranty requirements.

H. Coordination with Turf Areas (Lawns): Plant trees, shrubs, and other plants after finish grades are established and before planting turf areas unless otherwise indicated.

1. When planting trees, shrubs, and other plants after planting turf areas, protect turf areas, and promptly repair damage caused by planting operations.

1.10 MAINTENANCE

1. Maintenance Service: Provide maintenance by skilled employees of landscape Installer. Maintain as required in Part 3. Begin maintenance immediately after plants are installed and continue until plantings are acceptably healthy and well established but for not less than maintenance period below.
    a. Maintenance Period: 90 days from date of planting completion for planting operations completed between April 1 and June 15.
    b. Maintenance Period: 90 days from date of planting completion for planting operations completed between September 1 and September 30.
    c. Planting operations completed between October 1 through October 15 will continue maintenance during next planting season until April 30.
    d. Planting operations completed between October 16 through October 31 will continue maintenance during next planting season until May 15.
    e. Planting operations completed by November 1 through November 30 will continue maintenance during next planting season until May 30.
2. Notify the Architect in writing upon the completion of the installation of the plant material operations, the beginning date of the maintenance period and the anticipated completion date of the maintenance period.

1.11 PLANT MATERIAL ACCEPTANCE AND WARRANTY

A. Plant Material Substantial Completion:
1. When all plant material is installed and at the end of the maintenance period specified in Part 3 of this section, the Contractor shall request the Architect, in writing, to inspect the work for Substantial Completion. Notify the Architect at least 10 days prior to the anticipated date of inspection.
    a. For Substantial Completion, all plantings must be installed as specified in the locations indicated on the plans or as directed in field by the Architect, they must be in robust health, free of tags, ribbons and string, true to name and specified size.
2. Furnish written instructions for maintenance of the planting to the Owner at the time of inspection for Substantial Completion. Maintenance instructions shall consist of, complete typed instructions indicating specific operations in watering, fertilizing, spraying and pruning that will be necessary to maintain plants and lawn areas in a healthy condition.
3. When the plant material and workmanship are acceptable or upon the completion of the documented corrective work has been completed and maintenance instructions have been received by the Owner the Architect will certify in writing the Substantial Completion of the planting and initiating the beginning date of the warranty period.

B. Warranty: Installer agrees to repair or replace plantings and accessories that fail in materials, workmanship, or growth within specified warranty period.
1. Failures include, but are not limited to, the following:
    a. Death and unsatisfactory growth, except for defects resulting from abuse, lack of adequate maintenance, or neglect by Owner, or incidents that are beyond Contractor's control.
    b. Structural failures including plantings falling or blowing over.
    c. Faulty performance of tree stabilization.

2. Warranty Periods from Date of Substantial Completion:
   a. Trees, Shrubs, Vines, and Ornamental Grasses: 12 months.
   b. Ground Covers, Biennials, Perennials, and Other Plants: 12 months.
3. Include the following remedial actions as a minimum:
   a. Immediately remove dead plants and replace unless required to plant in the succeeding planting season.
   b. Replace plants that are more than 25 percent dead or in an unhealthy condition at end of warranty period.
   c. A limit of one replacement of each plant will be required except for losses or replacements due to failure to comply with requirements.
   d. All replacement plant material shall be of the same species; cultivar size as specified in the Plant Schedule
   e. Provide extended warranty for period equal to original warranty period, for replaced plant material.
   f. Restore areas damaged or disturbed by replacement operations to their original condition.

C. At the end of the warranty period or as directed by the Architect at the Substantial Completion, remove and dispose of guys, wires, rubber hose sections, stakes, and tree trunk wrapping off site.

D. Final Inspection and Final Acceptance:
1. At the end of the warranty period, inspection will be made by the Architect upon written request submitted by the Contractor. Notify the Architect at least 10 days before the anticipated date.
2. The Architect will review the plant material for acceptance or direct the Contractor for corrective work required, including plant replacement. Upon the Architects satisfaction of the completed work, the Architect will certify in writing the Final Acceptance of the planting.

PART 2 - PRODUCTS

2.01 PLANTING SOILS

A. Topsoil: Topsoil shall be natural, fertile, friable soil, without admixture of subsoil, clean and reasonably free from clay, lumps, stones, stumps, roots or similar materials and free from debris or other objects which might be a hindrance to planting operations, and as follows:
1. Obtain topsoil from local sources and are from naturally, well drained sites where topsoil occurs at a depth of not less than 4 inches.
2. Texture: Topsoil shall be a “sandy loam” as determined by mechanical analysis and based on the “USDA Textural Classification” and it shall conform to the following grain size distribution
   a. Percent passing by weight:

U.S. Standard Sieve	Minimum	Maximum
½”		100
#10	81	93
#18	66	87
#35	52	82

#60	35	66
#140	12	34
#300	5	18
Silt	4	13
Clay	1	5

3. pH value: Portion of the sample that passes a ¼ inch sieve shall fall within a range of pH 5.5 to pH 7.0.
4. Organic Matter:
   a. Portion of the sample which passes ¼ inch sieve shall contain not less than 5 percent nor more than 7 percent organic matter, as determined by the wet combustion method on a sample directed at 105°C.
   b. To adjust organic matter content, the soil may be amended, prior to site delivery, by the addition of composted humus. Use of organic amendments is acceptable only if random soil sampling indicates thorough incorporation.

2.02 PLANT MATERIAL

A. A complete list of plants, including a schedule of sizes, quantities and other requirements, shall be shown on the Drawings. In the event that quantity discrepancies or material omissions occur between the plant materials schedule and the Drawings, the Contractor shall be responsible in providing the higher quantity of plants.

B. Furnish nursery-grown plants true to genus, species, variety, cultivar, stem form, shearing, and other features indicated in Plant Schedule shown on Drawings and complying with ANSI Z60.1; and with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully branched, healthy, vigorous stock, densely foliated when in leaf and free of disease, pests, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.
   1. Trees with damaged, crooked, or multiple leaders; tight vertical branches where bark is squeezed between two branches or between branch and trunk ("included bark"); crossing trunks; cut-off limbs more than 3/4 inch in diameter; or with stem girdling roots will be rejected.
   2. Collected Stock: Do not use plants harvested from the wild, from native stands, from an established landscape planting, or not grown in a nursery unless otherwise indicated.

C. Provide plants of sizes, grades, and ball or container sizes complying with ANSI Z60.1 for types and form of plants required. Plants of a larger size may be used if acceptable to Architect, with a proportionate increase in size of roots or balls.

D. Plants shall be balled and burlapped unless otherwise specified and must be moved with the root systems as solid units with balls of earth firmly wrapped with untreated eight-ounce burlap, firmly held in place by a stout cord or wire. The diameter and depth of the balls of earth must be sufficient to encompass the fibrous root feeding system necessary for the healthy development of the plant.
   1. No plant shall be accepted when the ball of earth surrounding its roots has been badly cracked or broken preparatory to or during the process of planting or after the burlap, staves, ropes or platform required in connection with its transplanting have been removed. The plants and root balls shall remain intact during all operations.

E. Root-Ball Depth: Furnish trees and shrubs with root balls measured from top of root ball, which shall begin at root flare according to ANSI Z60.1. Root flare shall be visible before planting.

F. Labeling: Label at least one plant of each variety, size, and caliper with a securely attached, waterproof tag bearing legible designation of common name and full scientific name, including genus and species. Include nomenclature for hybrid, variety, or cultivar, if applicable for the plant as shown on Drawings.

G. If formal arrangements or consecutive order of plants is shown on Drawings, select stock for uniform height and spread, and number the labels to assure symmetry in planting.

2.03 INORGANIC SOIL AMENDMENTS

A. Lime: ASTM C 602, agricultural liming material containing a minimum of 80 percent calcium carbonate equivalent and as follows:
1. Class: T, with a minimum of 99 percent passing through No. 8 sieve and a minimum of 75 percent passing through No. 60 sieve.
2. Provide lime in form of ground dolomitic limestone.

B. Aluminum Sulfate: Commercial grade, unadulterated.

C. Perlite: Horticultural perlite, soil amendment grade.

D. Agricultural Gypsum: Minimum 90 percent calcium sulfate, finely ground with 90 percent passing through No. 50 sieve.

E. Sand: Gravelly sand that meets ASTM D 422 is clean, washed, natural or manufactured and free of toxic materials.
1. Percent passing by weight:

U.S. Standard Sieve	Minimum	Maximum
2”		100
¾”	70	100
¼”	50	80
#40	15	40
#200	0	3

F. Diatomaceous Earth: Calcined, 90 percent silica, with approximately 140 percent water absorption capacity by weight.

2.04 ORGANIC SOIL AMENDMENTS

A. Compost: Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through 1/2-inch sieve; soluble salt content of 5 to 10 decisiemens/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:
1. Organic Matter Content: 50 to 60 percent of dry weight.

B. Sphagnum Peat: Humus or Peat Moss shall be natural humus, reed peat or sedge peat, finely divided peat, decomposed and free of fibers with a minimum 60 per cent Sphagnum composition by volume. pH range approximately 5.5 pH to 7.5 pH and the organic matter shall be not less than 85% as determined by loss on ignition. The minimum water absorbing ability shall be 200% by weight on an oven-dry basis.

C. Muck Peat: Partially decomposed moss peat, native peat, or reed-sedge peat, finely divided or of granular texture, with a pH range of 6 to 7.5, and having a water-absorbing capacity of 1100 to 2000 percent.

D. Manure: Well-rotted, unleached, stable or cattle manure containing not more than 25 percent by volume of straw, sawdust, or other bedding materials; free of toxic substances, stones, sticks, soil, weed seed, and material harmful to plant growth.

2.05 FERTILIZERS

A. Bonemeal: Commercial, raw or steamed, finely ground; a minimum of 4 percent nitrogen and 20 percent phosphoric acid.

B. Superphosphate: Commercial, phosphate mixture, soluble; a minimum of 20 percent available phosphoric acid.

C. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:

D. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:
1. Composition: 20 percent nitrogen, 10 percent phosphorous, and 10 percent potassium, by weight.
2. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.

E. Planting Tablets: Tightly compressed chip type, long-lasting, slow-release, commercial-grade planting fertilizer in tablet form. Tablets shall break down with soil bacteria, converting nutrients into a form that can be absorbed by plant roots.
1. Size: 10-gram tablets.
2. Nutrient Composition: 20 percent nitrogen, 10 percent phosphorous, and 5 percent potassium, by weight plus micronutrients.

2.06 MULCHES

A. Organic Mulch: Free from deleterious materials and suitable as a top dressing of trees and shrubs, consisting of one of the following:
1. Type: Shredded hardwood, pine, fir or spruce.
2. Size Range: 3 inches maximum, 1/2 inch minimum.
3. Color: Natural.

B. Compost Mulch: Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through 1-inch sieve; soluble

salt content of 2 to 5 decisiemens/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:

1. Organic Matter Content: 50 to 60 percent of dry weight.

2.07 TREE STABILIZATION MATERIALS (OPTIONAL)

A. Stakes and Guys:
   1. Upright and Guy Stakes: Rough-sawn, sound, new hardwood, free of knots, holes, cross grain, and other defects, 2-by-2-inch nominal by length indicated, pointed at one end.
   2. Wood Deadmen: Timbers measuring 8 inches in diameter and 48 inches long, treated with specified wood pressure-preservative treatment.
   3. Flexible Ties: Wide rubber or elastic bands or straps of length required to reach stakes or turnbuckles.
   4. Tree-Tie Webbing: UV-resistant polypropylene or nylon webbing with brass grommets.
   5. Guy Cables: Five-strand, 3/16-inch- diameter, galvanized-steel cable, with zinc-coated turnbuckles, a minimum of 3 inches long, with two 3/8-inch galvanized eyebolts.
   6. Flags: Standard surveyor's plastic flagging tape, white, 6 inches long.

2.08 WATER

A. Water: Suitable for irrigation and free from ingredients harmful to plant life. Hose and other watering equipment required for the work shall be furnished by the Contractor.

2.09 MISCELLANEOUS PRODUCTS

A. Antidesiccant: Water-insoluble emulsion, permeable moisture retarder, film forming, for trees and shrubs. Deliver in original, sealed, and fully labeled containers and mix according to manufacturer's written instructions.

B. Mycorrhizal Fungi: Dry, granular inoculant containing at least 5300 spores per lb of vesicular-arbuscular mycorrhizal fungi and 95 million spores per lb of ectomycorrhizal fungi, 33 percent hydrogel, and a maximum of 5.5 percent inert material.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas to receive plants for compliance with requirements and conditions affecting installation and performance.
   1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
   2. Do not mix or place soils and soil amendments in frozen, wet, or muddy conditions.
   3. Suspend soil spreading, grading, and tilling operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
   4. Uniformly moisten excessively dry soil that is not workable and which is too dusty.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

C. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Architect and replace with new planting soil.

3.02 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities and turf areas and existing plants from damage caused by planting operations.

B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

C. Lay out individual tree and shrub locations and areas for multiple plantings. Stake locations, outline areas, adjust locations when requested, and obtain Architect's acceptance of layout before excavating or planting.
1. Notify Architect 5 days prior to the first day of planting operations and after the completion of layout.
2. Make minor adjustments to the plant arrangements in the field from those indicated on the plans if directed to do so by the Architect

D. Apply anti-desiccant to trees and shrubs using power spray to provide an adequate film over trunks (before wrapping), branches, stems, twigs, and foliage to protect during digging, handling, and transportation.
1. If deciduous trees or shrubs are moved in full leaf, spray with anti-desiccant at nursery before moving and again two weeks after planting.

E. Wrap trees and shrubs with burlap fabric over trunks, branches, stems, twigs, and foliage to protect from wind and other damage during digging, handling, and transportation.

3.03 PLANTING AREA ESTABLISHMENT

A. Loosen subgrade of planting areas to a minimum depth of 8 inches. Remove stones larger than 1 inch in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.

B. Soil additives shall be spread and thoroughly incorporated into the layer of topsoil by harrowing or other methods approved by the Architect. The following soil additives shall be incorporated.
1. Ground limestone as required by soil analysis to achieve a pH of 6.0 to 6.5, with a minimum application of 60 pounds per 1,000 square feet and a maximum application of 100 pounds per 1,000 square feet per season.
   a. Mix limestone with dry soil before mixing fertilizer.
2. Fertilizer as required by soil analysis with a minimum application of 20 pounds per 1,000 square feet of 10-10-10.
   a. Delay mixing fertilizer with planting soil if planting will not proceed within a few days.
3. Superphosphate at the rate of 20 pounds per 1,000 square feet.

C. Finish Grading: Grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

D. Before planting, obtain Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

3.04 EXCAVATION FOR TREES AND SHRUBS

A. Planting Pits and Trenches: Excavate circular planting pits with sides sloping inward at a 45-degree angle. Excavations with vertical sides are not acceptable. Trim perimeter of bottom leaving center area of bottom raised slightly to support root ball and assist in drainage away from center. Do not further disturb base. Ensure that root ball will sit on undisturbed base soil to prevent settling. Scarify sides of planting pit smeared or smoothed during excavation.
1. Excavate approximately three times as wide as ball diameter for balled and burlapped stock.
2. Do not excavate deeper than depth of the root ball, measured from the root flare to the bottom of the root ball.
3. If area under the plant was initially dug too deep, add soil to raise it to the correct level and thoroughly tamp the added soil to prevent settling.
4. Maintain required angles of repose of adjacent materials as shown on the Drawings. Do not excavate subgrades of adjacent paving, structures, hardscapes, or other new or existing improvements.
5. Maintain supervision of excavations during working hours.
6. Keep excavations covered or otherwise protected when unattended by Installer's personnel.

B. Obstructions: Notify Architect if unexpected rock or obstructions detrimental to trees or shrubs are encountered in excavations.

C. Fill excavations with water and allow to percolate away before positioning trees and shrubs.

3.05 TREE AND SHRUB PLANTING

A. Before planting, verify that root flare is visible at top of root ball according to ANSI Z60.1. If root flare is not visible, remove soil in a level manner from the root ball to where the top-most root emerges from the trunk. After soil removal to expose the root flare, verify that root ball still meets size requirements.

B. Set balled and burlapped stock plumb and in center of planting pit or trench with root flare 2 inches above adjacent finish grades.
1. Use planting soil for backfill and mix in the following proportions:
   a. 3 parts topsoil.
   b. 1 part manure, peat humus or compost
   c. 10 pounds bone meal per 1 cubic yard of mixture.
2. After placing some backfill around root ball to stabilize plant, carefully cut and remove burlap, rope, and wire baskets from tops of root balls and from sides, but do not remove from under root balls. Remove pallets, if any, before setting. Do not use planting stock if root ball is cracked or broken before or during planting operation.

3. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
4. Place planting tablets in each planting pit when pit is approximately one-half filled; in amounts recommended in soil reports from soil-testing laboratory. Place tablets beside the root ball about 1 inch from root tips; do not place tablets in bottom of the hole.
5. Continue backfilling process. Water again after placing and tamping final layer of soil.

C. Set container-grown stock plumb and in center of planting pit or trench with root flare 1 inch above adjacent finish grades.
1. Use planting soil for backfill.
2. Carefully remove root ball from container without damaging root ball or plant.
3. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
4. Place planting tablets in each planting pit when pit is approximately one-half filled; in amounts recommended in soil reports from soil-testing laboratory. Place tablets beside the root ball about 1 inch from root tips; do not place tablets in bottom of the hole.
5. Continue backfilling process. Water again after placing and tamping final layer of soil.

D. When planting on slopes, set the plant so the root flare on the uphill side is flush with the surrounding soil on the slope; the edge of the root ball on the downhill side will be above the surrounding soil. Apply enough soil to cover the downhill side of the root ball.

3.06 TREE STABILIZATION (OPTIONAL)

A. Install trunk stabilization as follows unless otherwise indicated:
1. Upright Staking and Tying: Use a minimum of 3 stakes of length required to penetrate at least 18 inches below bottom of backfilled excavation and to extend 72 inches above grade. Set vertical stakes and space to avoid penetrating root balls or root masses.
2. Support trees with bands of flexible ties at contact points with tree trunk. Allow enough slack to avoid rigid restraint of tree.
3. Support trees with two strands of tie wire, connected to the brass grommets of tree-tie webbing at contact points with tree trunk. Allow enough slack to avoid rigid restraint of tree.
4. Site-Fabricated Staking-and-Guying Method:
    a. For trees more than 6 inches in caliper, anchor guys to wood deadmen buried at least 36 inches below grade. Provide turnbuckle for each guy wire and tighten securely.
    b. Support trees with bands of flexible ties at contact points with tree trunk and reaching to turnbuckle. Allow enough slack to avoid rigid restraint of tree.
    c. Support trees with strands of cable or multiple strands of tie wire, connected to the brass grommets of tree-tie webbing at contact points with tree trunk and reaching to turnbuckle. Allow enough slack to avoid rigid restraint of tree.
    d. Attach flags to each guy wire, 30 inches above finish grade.

3.07 TREE AND SHRUB PRUNING

A. Remove only dead, dying, or broken branches. Do not prune for shape.

B. Prune, thin, and shape trees, shrubs, and vines as directed by Architect.

C. Prune, thin, and shape trees and shrubs according to standard professional horticultural and arboricultural practices. Unless otherwise indicated by Architect, do not cut tree leaders; remove only injured, dying, or dead branches from trees and shrubs; and prune to retain natural character.

D. Do not apply pruning paint to wounds.

3.08 PLANT MAINTENANCE

A. Maintain plantings by pruning, cultivating, watering, weeding, fertilizing, mulching, restoring planting saucers, adjusting and repairing tree-stabilization devices, resetting to proper grades or vertical position, and performing other operations as required to establish healthy, viable plantings. Spray or treat as required to keep trees and shrubs free of insects and disease.

B. Water all plant material by applying water twice within the first 24 hours of the time of planting and all plants during the maintenance period shall be watered at least twice each week unless sufficient rainfall has occurred. At each watering the soil around each tree or shrub shall be thoroughly saturated. If sufficient moisture is retained in the soil, as determined by the Architect, the required watering may be reduced.
1. Trees will require a minimum of 10 gallons of water each week
2. Shrubs will require a minimum of 5 gallons of water each week.

C. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace mulch materials damaged or lost in areas of subsidence.

D. Apply treatments as required to keep plant materials, planted areas, and soils free of pests and pathogens or disease. Use integrated past management practices whenever possible to minimize the use of pesticides and reduce hazards. Treatments include physical controls such as hosing off foliage, mechanical controls such as traps, and biological control agents.

3.09 CLEANUP AND PROTECTION

A. During planting, keep adjacent paving and construction clean and work area in an orderly condition.

B. Protect plants from damage due to landscape operations and operations of other contractors and trades. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged plantings.

C. After installation and before Substantial Completion, remove nursery tags, nursery stakes, tie tape, labels, wire, burlap, and other debris from plant material, planting areas, and Project site.

3.10 DISPOSAL

A. Remove surplus soil and waste material including excess subsoil, unsuitable soil, trash, and debris and legally dispose of them off Owner's property.

END OF SECTION 32 93 00

SECTION 33 11 00
WATER UTILITY DISTRIBUTION SYSTEM

PART 1 - GENERAL

1.1 PROVISIONS INCLUDED

A. General provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes water-distribution piping for the external fire suppression system and domestic water service and related components including connection to approximately 10 feet outside the building.

B. Related Sections include the following:

1. Division 31 Section “Earth Moving” for excavation, trenching and backfilling.
2. Division 32 Section “Underground Storage for Fire Suppression Water”.
3. Division 21 Fire Suppression.
4. Division 22 Plumbing.

1.3 REFERENCED STANDARDS

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

1. ASTM E548: Generic Criteria for Use in Evaluation of Testing and Inspection Agencies.

B. American Water Works Association (AWWA).

1. AWWA B300: Hypochlorites.
2. AWWA B301: Chlorine – Liquid.
3. AWWA C500: Gate Valves 3 through 48 Inch NPS, for Water and Sewage Systems.
4. AWWA C601: Disinfecting Water Mains

C. National Fire Prevention Association (NFPA): NFPA No. 24: Private Fire Service Mains.

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's specifications and installation instructions for all products specified in this section, including pipes and valves. Obtain Turners Fall Fire Department/District and Water Department approvals prior to submittal to the Architect.

B. Field quality-control test reports: Submit test reports for each test within 10 working days after the test completion.

1. Hydrostatic Test

2. Disinfection Test

C. Operation and Maintenance Data: For water valves and specialties to include in emergency, operation, and maintenance manuals.

D. Disposal method: Submit to the Architect the proposed method for disposal of waste water from flushing, hydrostatic testing and disinfection a minimum of 10 working days before performing flushing.

1.5 QUALITY ASSURANCE

A. Local Regulations: Water system products to meet the requirements of the Turners Falls Water Department and the Turners Falls Fire Department/District.

B. Insurance Requirements: All water system products shall meet the requirements of the Owner's insurance underwriters.

C. Testing and Inspection Agency Qualifications: An independent testing agency approved by the Architect and acceptable to the Town. Testing laboratory approval will be based on compliance with ASTM E548.

D. Piping materials shall bear label, stamp, or other markings of specified testing agency.

E. Comply with FMG's "Approval Guide" or UL's "Fire Protection Equipment Directory" for fire-service-main products.

F. NFPA Compliance: Comply with NFPA 24 for materials, installations, tests, flushing, and valve and hydrant supervision for fire-service-main piping for fire suppression.

G. NSF Compliance:

1. Comply with NSF 61 for materials for water-service piping and specialties for domestic water.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Preparation for Transport: Prepare valves according to the following:

1. Ensure that valves are dry and internally protected against rust and corrosion.
2. Protect valves against damage to threaded ends and flange faces.
3. Set valves in best position for handling. Set valves closed to prevent rattling.

B. During Storage: Use precautions for valves according to the following:

1. Do not remove end protectors unless necessary for inspection; then reinstall for storage.
2. Protect from weather. Store indoors and maintain temperature higher than ambient dew-point temperature. Support off the ground or pavement in watertight enclosures when outdoor storage is necessary.

C. Handling: Use sling to handle valves if size requires handling by crane or lift. Rig valves to avoid damage to exposed parts. Do not use hand wheels or stems as lifting or rigging points.

D. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.

E. Protect stored piping from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing inside.

F. Protect flanges, fittings, and specialties from moisture and dirt.

PART 2 - PRODUCTS

2.1 DUCTILE-IRON PIPE AND FITTINGS

A. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, Class 52, with mechanical-joint bell and plain spigot end between mains and hydrants and on water mains where slope exceeds 4%.

1. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.

2. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

B. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, Class 52, with push-on-joint bell and plain spigot end where pipe is restrained at both ends and where slope is less than 4%.

1. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.

2. Gaskets: AWWA C111, rubber.

C. Flanges: ASME 16.1, Class 125, cast iron.

2.2 PIPING SPECIALTIES

A. Transition Fittings: Manufactured fitting or coupling same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.

2.3 GATE VALVES

A. AWWA, Cast-Iron Gate Valves:

1. Non-rising-Stem, Resilient-Seated Gate Valves: Gray- or ductile-iron body and bonnet; with bronze or gray- or ductile-iron gate, resilient seats, bronze stem, and stem nut.

a. Standard: AWWA C509.

b. Minimum Pressure Rating: 200 psig.

c. End Connections: Mechanical joint.

d. Interior Coating: Complying with AWWA C550.

2.4 GATE VALVE ACCESSORIES AND SPECIALTIES

A. Valve Boxes: Comply with AWWA M44 for cast-iron valve boxes. Include top section, adjustable extension of length required for depth of burial of valve, plug with lettering "WATER," and bottom section with base that fits over valve and with a barrel approximately 5 inches in diameter.

1. Operating Wrenches: Steel, tee-handle with one pointed end, stem of length to operate deepest buried valve, and socket matching valve operating nut.

2.5 FIRE HYDRANTS

A. Fire Hydrants: Furnish dry barrel type conforming to AWWA C502, with a valve opening of at least 5-1/4 inches in diameter, with bronze working parts, and with the following connections:

1. One 6 inch bell connection
2. Two 2-1/2-inch hose connections
3. One 4-1/2-inch pumper connection.

B. Furnish fire hydrants which conform to the requirements of the Turners Falls Fire District/Department, Water Department, and Department of Public Works. It is the responsibility of the Contractor to determine local fire and water department requirements. Items requiring conformance include the following:

1. Hose thread sizes.
2. Size and configuration of operating and nozzle cap nuts.
3. Turning direction to open hydrants.
4. Acceptable Manufacturers.
5. Hydrant Flag.

C. Finish: One coat of rust-inhibitive primer and two coats of exterior enamel paint. Color shall be as directed by the Fire Department/District.

2.6 EARTHWORK

A. Refer to Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

2.7 PIPING INSTALLATION

A. Install ductile-iron, water-service piping according to AWWA C600 and AWWA M41.

B. Bury piping with depth of cover over top at least 60 inches, with top at least 12 inches below level of maximum frost penetration.

C. Install piping by tunneling or jacking, or combination of both, under streets and other obstructions that cannot be disturbed.

D. Extend water-service piping and connect to water-supply source and building-water-piping systems at outside face of building wall in locations and pipe sizes indicated.

1. Terminate water-service piping at building wall until building-water-piping systems are installed. Terminate piping with caps, plugs, or flanges as required for piping material. Make connections to building-water-piping systems when those systems are installed.

E. Install underground piping with restrained joints at horizontal and vertical changes in direction. Use restrained-joint piping, thrust blocks, anchors, tie-rods and clamps, and other supports.

2.8 ANCHORAGE INSTALLATION

A. Anchorage, General: Install water-distribution piping with restrained joints. Anchorages and restrained-joint types that may be used include the following:

1. Bolted flanged joints.
2. Restraining glands.
3. Pipe clamps and tie rods.

B. Install anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches. Include anchorages for the following piping systems:

1. Gasketed-Joint, Ductile-Iron, Water-Service Piping: According to AWWA C600.

2. Fire-Service-Main Piping: According to NFPA 24.

C. Apply full coat of asphalt or other acceptable corrosion-resistant material to surfaces of installed ferrous anchorage devices.

2.9 VALVE INSTALLATION

A. AWWA Gate Valves: Comply with AWWA C600 and AWWA M44. Install each underground valve with stem pointing up and with valve box.

B. AWWA Valves Other Than Gate Valves: Comply with AWWA C600 and AWWA M44.

C. MSS Valves: Install as component of connected piping system.

D. Corporation Valves and Curb Valves: Install each underground curb valve with head pointed up and with service box.

2.10 FIELD QUALITY CONTROL

A. Piping Tests: Conduct piping tests before joints are covered and after concrete thrust blocks have hardened sufficiently. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Use only potable water.

B. Perform field tests on water service lines as specified in this section. Provide all labor, equipment and incidentals required for testing. The cost of the field testing shall not be charged to the cash allowances for testing laboratory services.

C. Perform at no additional cost to the Owner, additional field tests on water service lines required by the Town. Prior to beginning testing, ascertain the extent of additional testing required by the Turners Falls Fire District/Department, Water Department, and Department of Public Works.

D. If there is disagreement between standards as required by the Contract Documents and the Town, the more stringent standards shall govern.

E. Provide a minimum of 48 hours notice to the Turners Falls Department of Public Works, Water Department and to the Architect. Do not perform testing of the water system without a representative of the Water Department present.

F. Should the water service line fail to meet the requirements specified, the Contactor shall perform the necessary work, including retesting at no additional cost to the Owner.

G. Hydrostatic Tests: Test at not less than one-and-one-half times working pressure for two hours.

1. Increase pressure in 50-psig increments and inspect each joint between increments. Hold at test pressure for 1 hour; decrease to 0 psig. Slowly increase again to test pressure and hold for 1 more hour. Maximum allowable leakage is 2 quarts per hour per 100 joints. Remake leaking joints with new materials and repeat test until leakage is within allowed limits.

a. Test Duration: 2 hours

b. Test Pressure: 200 psi

H. Leakage is defined as the quantity of water to be supplied into the newly laid pipe, or any valved section of piping, necessary to maintain the specified test pressure after the pipe has been filled with water and the air expelled. Maximum allowable leakage shall be as required by the Turner Falls Water Department.

I. Carefully examine exposed pipe, joints, fittings and valves during the partially open trench test.

J. When test results exceed the maximum allowable leakage, make corrections and retest at no additional cost to the Owner. Correct visible leaks regardless of test results.

K. Prepare reports of testing activities.

2.11 IDENTIFICATION

A. Install continuous underground detectable warning tape during backfilling of trench for underground water-distribution piping. Locate below finished grade, directly over piping. Underground warning tapes are specified in Division 31 Section "Earth Moving."

2.12 CLEANING

A. Clean and disinfect water-distribution piping as follows:

1. Purge new water-distribution piping systems and parts of existing systems that have been altered, extended, or repaired before use.

2. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in AWWA C651 or do as follows:

    a. Fill system or part of system with water/chlorine solution containing at least 50 ppm of chlorine; isolate and allow to stand for 24 hours.

    b. Open and closed valves each valve on the lines being disinfected several times during the contact period.

    c. After standing time, flush system with clean, potable water until less than 0.2 ppm of chlorine remains in water coming from system.

    d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedure if biological examination shows evidence of contamination.

B. Prepare reports of purging and disinfecting activities.

END OF SECTION 33 11 00

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SECTION 33 31 00
SANITARY UTILITY SEWERAGE SYSTEM

PART 1 - GENERAL

1.01 SUMMARY

A. Work Included: All exterior piping, fittings, and structures to and including connection to the building service at a point approximately 10 feet outside building as shown on the Drawings.

B. Related Work Specified in Other Sections.
1. Excavation, trenching and backfilling: Division 31 - Earthwork
2. Concrete work: Section 03 30 00.

1.02 SUBMITTALS

A. Product data for pipe, manholes, frames and castings.

B. Test reports: Submit test reports for each test within 10 working days after test completion.
1. Alignment test.
2. Low pressure air test.

1.03 QUALITY ASSURANCE

A. Testing and Inspection Agency Qualifications: An independent testing agency approved by the Architect and acceptable to the city. Testing laboratory approval will be based on compliance with ASTM E 548.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Pipe and fittings shall be inspected upon delivery and before being installed. Damaged pipe and fittings shall be removed from the work site, and shall be replaced at no additional cost to the Owner.

B. Inside of pipes and fittings shall be kept free of dirt and debris. Plug pipe and fitting ends.

C. Plastic pipe shall be protected from exposure to direct sunlight over extended periods.

D. Solvents, solvent compounds, lubricants, elastomeric gaskets, and any other materials required to install the plastic pipe shall be stored in accordance with the manufacturer's recommendation and shall be discarded if the storage period exceeds the recommended shelf life.

1.05 SITE CONDITIONS

A. Site information: Perform site survey, research public utility records and verify existing utility locations. Verify that the sanitary sewage system may be installed in compliance with the original design and standards.

PART 2 - PRODUCTS

2.01 BEDDING AND BACKFILL MATERIAL

A. Bedding and backfill material shall conform to Section 02300.

2.02 POLYVINYL CHLORIDE PIPE, JOINTS AND FITTINGS

A. Gravity Sewer Pipe:
1. Sizes 4 inch through 8 inch diameter: Polyvinyl chloride (PVC) pipe shall conform to ASTM D 3034, Type PSM with a maximum SDR of 35.
2. Joints shall conform to ASTM D 3212, elastomeric gasket type. Gaskets shall conform to ASTM F 477.
3. Fittings shall conform to ASTM D 3034, Type PSM with a maximum SDR of 35.
4. Branch connection shall be made by use of regular fittings or solvent cemented saddles as approved by Architect. Saddles for PVC pipe shall comply with Table 4 of ASTM D 3034.

2.04 MANHOLES

A. Manholes shall be of precast concrete. Precast concrete sections shall conform to ASTM C 478, except that Portland cement shall conform to ASTM C 150, Type IIA. Concrete shall have a minimum compressive strength of 4000 psi at 28 days.
1. Joints for precast reinforced concrete manhole sections shall be O-ring rubber gaskets or compressible filler such as Kent Seal No. 2 joint sealant or approved equal.
2. Exterior surfaces of manholes shall be painted with two coats of Bitumastic No. 28 as manufactured by Koppers Company, or approved equal.

B. Brick: ASTM C 32, Grade MS.

C. Mortar: Portland cement mortar, ASTM C 270, Type M. Use ASTM C 150, Type IIA cement.

D. Frames and covers: Frames and covers shall be LeBaron LK110, or approved equal. The word SEWER shall be cast on the cover in 2 inch high letters. The frames and covers shall have a combined weight of not less than 400 pounds and shall conform to ASTM A 48, Class 20B.

E. Manhole Steps: Dropfront type rung of steel reinforced co-polymer polypropylene plastic.
1. Steps: 1-3/16 inches in diameter, with 14 inches of width, and project a minimum of 5-1/8 inches from the inside face of the manhole.
2. Reinforcing Steel: Grade 60 and 1/2 inch in diameter.

F. Pipe Connections: ASTM C 443. Manufactured manhole connections shall be neoprene boot, 3/8 inch minimum thickness, as manufactured by Kor-N-Seal, or approved equal.

G. Cement mortar parging: Cement mortar shall conform to ASTM C 150, Type IIA cement.

H. Additional materials for adjustment grade of existing structures:
1. Precast concrete adjustment rings: Concrete shall have a minimum compressive strength of 5000 psi at 28 days. Steel reinforcement shall conform to ASTM A615. Grade 60 and shall have 1 inch minimum cover.

PART 3 - EXECUTION

3.01 GENERAL EXECUTION REQUIREMENTS

A. Adjacent water service.
   1. Where the location of the sewer line is not clearly defined by dimensions on the Drawings, the sewer shall not be closer horizontally than 10 feet to a water service line except that where the bottom of the water pipe will be at least 12 inches above the top of the sewer pipe, the horizontal spacing may be a minimum of 6 feet.
   2. Where gravity flow sewers cross above water lines, the sewer pipe for a distance of 10 feet on each side of the crossing shall be fully encased in concrete or shall be of pressure pipe, as approved by Architect, with no joint closer horizontally than 3 feet to the crossing. The thickness of the concrete encasement including that at the pipe joints shall not be less than 4 inches to pipe.

B. Trenches shall be kept free of water and as dry as possible during bedding, laying and jointing and for as long a period as required. Pipe shall not be laid in water or when trench conditions are unsuitable for the work.

C. Each pipe shall be laid accurately to the line and grade shown on the Drawings.

D. Pipe laying will not be allowed to begin at any point other than a manhole or other appurtenance.

E. Pipes entering or leaving manholes shall not exceed 2 feet in length as measured from the inside face of the manhole wall.

F. Pipes entering or leaving manholes shall extend a minimum of 1 inch into the manhole as measured from the inside face of the manhole wall.

G. Pipe laying shall proceed upgrade with the spigot ends of bell and spigot pipe pointing in the direction of the flow.

H. When work is not in progress, open ends of pipe and fittings shall be plugged so that no trench water or other material will enter the pipe or fitting.

I. The full length of each section of pipe shall rest solidly upon the pipe bed, with recesses excavated to accommodate bells, couplings, and joints.

J. Pipe cutting.
   1. Where required, sections of pipe may be cut to provide shorter sections of pipe necessary for the construction. The cutting of the pipe shall be done in accordance with the pipe manufacturer's recommendations and subject to the approval of the Architect.
   2. In general, the pipe material shall be cut by using a saw or milling process, approved by the pipe manufacturer and not by using any impact device, such as a hammer and chisel, to break the pipe. The pipe shall be cut, not broken. The cut end of the pipe shall be square to the axis of the pipe and any rough edges ground smooth.

K. Before testing sanitary sewer lines the Contractor shall thoroughly clean sanitary sewers by flushing with water or other means to remove debris. Minimum water flow shall be 50 gallons per minute.

1. Each run of pipe between manholes shall be flushed individually and the debris caught in and removed from the lower manhole.
2. Water shall be introduced at the manhole, in the run of pipe being cleaned, with the highest invert elevation.
3. The Contractor shall make a visual inspection of sanitary sewer lines and manholes after flushing to verify that all debris has been removed. Repeat flushing if necessary, at no additional cost to Owner.
4. Water for testing must be prearranged with the Water Department. Any fees will be the responsibility of the Contractor.

3.02 EXCAVATION

A. Excavation shall be in accordance with Section 31 20 00.

3.03 INSTALLATION

A. Polyvinyl chloride pipe.
1. Before making pipe joints ensure all surfaces are clean and dry.
2. Lubricants shall be used as recommended by the pipe manufacturer.
3. Installations of solvent weld joint pipe, using PVC pipe and fittings shall be installed in accordance with ASTM F 402.

3.04 BACKFILLING AND COMPACTION

A. Special backfilling and compaction requirements.
1. As soon as possible after the joint is made sufficient, the pipe shall be backfilled and compacted with sand fill to a depth of 6 inches above top of pipe.
2. Completion of backfilling and compaction shall not take place until testing has been completed and accepted.

3.05 MANHOLE CONSTRUCTION

A. General:
1. Install on compacted gravel base in accordance with Section 31 20 00.
2. Manhole steps shall be provided in all manholes. Steps shall be cast into the walls of the structures so as to form a continuous ladder with a distance of 12 inches between steps.

B. Manhole inverts and free drops:
1. The invert channels shall be smooth and semicircular in shape conforming to the inside of the adjacent sewer section. Changes in direction of flow shall be made with a smooth curve of as large a radius as the size of the manhole will permit. Changes in size and grade of the channels shall be made gradually and evenly.
2. The invert channels shall be formed directly in the concrete of the manhole base, or shall be built up with up brick and mortar.
3. The floor of the manhole outside the channels shall be smooth and shall slope toward the channels not less than 1 inch per foot nor more than 2 inches per foot.

C. Pipe connections:
1. Connect to precast bases using manufactured connections.
2. Seal connections to concrete block bases with flexible rubber connectors with stainless steel pipe clamps and expansion bands.

D. Jointing:
1. Brick shall be laid radially or in stretcher courses with every sixth course laid as a stretcher course or radially.
2. Mortar joints shall be completely filled and shall be smooth and free from surplus mortar on the inside of the manhole.
3. Installation of O-ring rubber gaskets between precast concrete sections shall be in accordance with the manufacturer's recommendations.
4. Joint between precast concrete sections shall be full-bedded in compressible filler and shall be smoothed to a uniform surface on both the interior and exterior of the manhole.

E. Parging: Riser sections constructed of brick or concrete block shall be parged on the exterior with a layer of cement mortar parging, 1/2 inch minimum thickness.

F. Frames and covers:
1. Frames shall be set on cement mortared brick courses to required grade and concentric with the opening.
   a. Concrete barrel block is not acceptable for grade adjustment.
2. All voids beneath the bottom flange and in the brick courses shall be filled to make water tight. A ring of cement mortar 1 inch thick, minimum, shall be placed around the outside of the bottom flange, extending to the top edge of the frame, all around the frame circumference.
3. Brick shall be parged on the exterior with a layer of cement mortar parging, 1/2 inch minimum thickness.

3.06 CONCRETE ENCASEMENT PLACEMENT

A. Place concrete on compacted material in trench bottom. Vertical sides of trench may be used instead of formwork provided that material is undisturbed and surface is as uniform and smooth as is practicable.

B. Concrete shall cure for a minimum of 24 hours before being backfilled.

3.07 TESTING REQUIREMENTS

A. General:

1. Perform field tests on sanitary sewers, at no additional cost to the Owner. Provide all labor, equipment and incidentals required for testing.

2. Perform additional field tests on sanitary sewers, at no additional cost to the Owner, as may be required by the Town, authorities or agencies to whose requirements the work is to be in accordance with.
   a. It is the Contractor's responsibility to ascertain the extent of additional testing required by the Town, authorities, or agencies involved in this work.
   b. If there is disagreement between standards as required by the Town, authorities or agencies and the Contract Documents, the stricter shall govern.

3. Begin testing within 10 working days after completion of sanitary sewer work.
   a. If a section of sanitary sewer line is not to be installed until later in the construction schedule, the sections of sanitary sewer line installed shall be tested within 10

working days after their completion, with the other sections tested within 10 working days after their installation.

4. The Contractor shall give a minimum of 48 hours notice before starting field testing to all interested parties.

5. Should the sanitary sewer pipe, as laid, fail to meet the requirements specified, the Contractor shall perform the necessary work, including re-testing, at no additional cost to the Owner, to meet the requirements specified.

B. Joints: Inspect joints.

C. Alignment test: The Contractor shall check each straight run of sanitary sewer pipe for gross deficiencies by holding a light in a manhole or the last section of pipe laid before connection is made; it shall show a practically full circle of light through the run of pipe when viewed from the adjoining end of line.

D. Air Test:

1. Test in accordance with the Uni-Bell PVC Pipe Association UNI-B-6 Recommended Practice for Low-Pressure Air Testing of Installed Sewer Pipe.

2. Use low pressure compressed air at 4 psig pressure greater than the groundwater backpressure. Measure the time for pressure loss of 0.5 psig. The maximum acceptable rate of air loss is 0.0015 cfm per square foot of internal pipe surface.

E. Manhole Vacuum Test: Draw a vacuum in the manhole of 10 inches of Mercury (Hg) and disconnect vacuum pump.

1. Test Duration: 1 minute

2. Maximum pressure increase: 1 inch of mercury (vacuum drop from 10 to 9 inches of mercury). If the pressure change exceeds 1-inch of mercury in 2 minutes, repair the manhole and retest.

END OF SECTION 33 31 00

SECTION 33 41 00
STORM UTILITY DRAINAGE PIPING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Procurement and Contracting Requirements and Division 01 General Requirements apply to this Section.

1.02 SUMMARY

A. This Section includes gravity-flow storm drainage outside the building, with the following components:
   1. Special fittings for expansion and deflection.
   2. Special fittings for material and size transition of piping.
   3. Cleanouts.
   4. Drains.
   5. Precast concrete manholes.
   6. Water Quality Units
   7. Catch Basins
   8. Outlet Control Structures
   9. Flared End Sections.

B. Alternates: Work of this Section is affected by Alternates. Refer to Division 01 Section "Alternates" for administrative and procedural requirements applicable to Alternates.

C. Related Work Specified in Other Sections:
   1. Division 01 Section "Project Record Drawings"
   2. Division 03 Section "Cast-in-Place Concrete"
   3. Division 31 Section "Earth Moving"

1.03 DEFINITIONS

A. CPE: Corrugated Polyethylene plastic.

1.04 SUBMITTALS

A. Product Data: For the following:
   1. Pipe and fittings.
   2. Drains.
   3. Catch basins.
   4. Manholes.
   5. Flared End Sections.
   6. Cleanouts.
   7. Drainage Castings.
   8. Water Quality Units

B. Field quality-control test reports.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Do not store plastic pipe and fittings in direct sunlight.

B. Protect pipe, pipe fittings, and seals from dirt and damage.

C. Handle manholes according to manufacturer's written rigging instructions.

D. Handle catch basins according to manufacturer's written rigging instructions.

1.06 PROJECT CONDITIONS

A. Interruption of Existing Storm Drainage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
1. Notify Architect and Owner no fewer than 7 days in advance of proposed interruption of service.

PART 2 - PRODUCTS

2.01 PIPE AND FITTINGS

A. Corrugated PE Pipe and Fittings: AASHTO MP7, Type S, with smooth waterway for coupling joints.
1. Basis of Design Product: ADS N-12 Smooth Interior HDPE pipe, by Advanced Drainage Systems, Inc., Ludlow, MA or approved equal.

B. CONCRETE PIPE
1. Reinforced-Concrete Pipe and Fittings: ASTM C 76 (ASTM C 76M), groove and tongue sealant joints with ASTM C 990 (ASTM C 990M), bitumen or butyl-rubber sealant.
2. Class IV, Wall.

2.02 MANHOLES, CATCH BASINS, DRYWELLS, OUTLET CONTROL STRUCTURES AND AREA DRAINS

A. Standard Precast Concrete Manholes: ASTM C 478, precast, reinforced concrete, of depth indicated, except that portland cement shall conform to ASTM C150, Type IIA; fabricate from concrete having a minimum compressive strength of 4,000 psi at 28 days.
1. Diameter: 48 inches minimum, unless otherwise indicated.
2. Install on compacted gravel base.
3. Joint Sealant: O-ring rubber gaskets, butyl rubber, or compressible filler such as Kent Seal No. 2 joint sealant or approved equal.
4. Pipe Connections:
   a. Portland Cement for Mortar: ASTM C150, Type IIA;
   b. Mortar mix: ASTM C270, Type M.
5. Steps: Drop front type rung of steel reinforced co-polymer polypropylene plastic.
   a. Steps shall be a minimum of 1-3/16 inches in diameter, with 14 inches of width, and project a minimum of 5-1/8 inches from the inside face of the manhole.

b. Reinforcing steel shall be grade 60 and ½ inch in diameter.

6. Precast Concrete Adjusting Rings: Fabricate from concrete which has a minimum compressive strength of 5,000 psi at 28 days, and steel reinforcement conforming to ASTM A615, Grade 60. Reinforcement shall have 1 inch minimum cover.
7. Manhole Frames and Covers: Gray Iron Castings as noted on the drawings, comply with AASHTO M306-07. The combined weight of the frame and cover shall be a minimum of 400 pounds. The word DRAIN shall be cast on the cover in 2-inch high letters. Acceptable models are:
   a. Model LK-110A by East Jordan Iron Works
   b. Model 1104B by Campbell Foundries
   c. Model R-1922 by Neenah Foundries
8. Catch Basin and Area Drain Frames and Grates: Gray Iron Castings as noted on the drawings, comply with AASHTO M306-07. Acceptable models are:
   a. Model LF-248-4-000 by East Jordan Iron Works
   b. Model 9301 (8" Frame) by Campbell Foundries
   c. Model R-3588-A by Neenah Foundries
9. Cement Mortar Parging: ASTM C270, Type M.
10. Oil Traps: Provide oil traps (also known as oil hoods) in all catch basins that are located within pavement areas. Oil Traps basis of design is East Jordan Iron Works Model # - L202-000 or approved equal.

2.03 CONCRETE

A. General: Cast-in-place concrete according to Division , and the following:
   1. Cement: ASTM C 150, Type II.
   2. Fine Aggregate: ASTM C 33, sand.
   3. Coarse Aggregate: ASTM C 33, crushed gravel.
   4. Water: Potable.

B. Portland Cement Design Mix: 4000 psi minimum, with 0.45 maximum water-cementitious materials ratio.
   1. Reinforcement Fabric: ASTM A 185, steel, welded wire fabric, plain.
   2. Reinforcement Bars: ASTM A 615/A 615M, Grade 60, deformed steel.

C. Ballast and Pipe Supports: Portland cement design mix, 3000 psi minimum, with 0.58 maximum water-cementitious materials ratio.
   1. Reinforcement Fabric: ASTM A 185, steel, welded wire fabric, plain.
   2. Reinforcement Bars: ASTM A 615/A 615M, Grade 60, deformed steel.

2.04 PIPE OUTLETS

A. Flared end sections: Reinforced concrete flared end sections.

PART 3 - EXECUTION

3.01 EARTHWORK

A. Excavation, trenching, and backfilling are specified in Division 31 Section "Earth Moving."

B. As soon as possible after the joint is made, and cement mortar allowed to cure, place sufficient bedding material, in 6 inch layers, along the pipe to springline, and compact to prevent pipe movement off line or grade.

C. Do not backfill until testing has been completed.

3.02 GENERAL INSTALLATION REQUIREMENTS

A. Trenches shall be kept free of water and as dry as possible during bedding, laying and jointing and for as long a period as required. Pipe shall not be installed in water or when trench conditions are unsuitable for the work.

B. Each pipe shall be installed accurately to the line and grade shown on the Drawings.

C. Pipe laying will not be allowed to begin at any point other than a manhole, catch basin or other appurtenance.

D. Pipes entering or leaving manholes, catch basins and other structures shall not exceed 2 feet in length as measured from the inside wall face.

E. Pipes entering or leaving manholes, catch basins or structures shall extend a minimum of 1 inch into the manhole, catch basin or structure as measured from the inside wall face.

F. Pipe laying shall proceed upgrade with the spigot ends of bell and spigot pipe, and the tongue ends of tongue and groove pipe pointing in the direction of slow.

G. When work is not in progress, open ends of pipe and fittings shall be plugged so that trench water or other material will not enter the pipe or fitting.

H. The full length of each section of pipe shall rest solidly upon the pipe bed, with recesses excavated to accommodate bells, couplings and joints.

I. Pipe cutting:
   1. Where required, sections of pipe may be cut to provide shorter sections of pipe necessary for the construction. Cut pipe in accordance with the pipe manufacturer's recommendations, and subject to the approval of the Architect.
   2. In general, to cut pipe, use a saw or milling process approved by the pipe manufacturer; do not use an impact device, such as a hammer and chisel, to break the pipe. The pipe shall be cut, not broken. The cut end of the pipe shall be square to the axis of the pipe and any rough edges ground smooth.

J. Before testing storm drainage lines, thoroughly clean pipe by flushing with water to remove debris.
   1. Each run of pipe between manholes or catch basins shall be flushed individually and the debris caught in and removed from the lower manhole or catch basin.
   2. Make a visual inspection of storm drainage lines, manholes, and catch basins after flushing to verify that all debris has been removed.

3.03 PIPE JOINT CONSTRUCTION

A. Polyethylene (PE) Plastic Pipe and Fittings: Join pipe, tubing, and fittings with couplings for soiltight joints according to AASHTO “Standard Specifications for Highways Bridges,” Division II, Section 26.4.2.4 “Joint Properties” and manufacturer’s written instructions.

B. Join dissimilar pipe materials with pressure-type couplings.

3.04 CLOSING ABANDONED STORM DRAINAGE SYSTEMS

A. Abandoned Piping: Close open ends of abandoned underground piping indicated to remain in place. Include closures strong enough to withstand hydrostatic and earth pressures that may result after ends of abandoned piping have been closed.

B. Backfill to grade according to Division 31 Section "Earth Moving."

3.05 FIELD QUALITY CONTROL

A. Testing and inspection is the responsibility of the Contractor. The Contractor, at his option, may perform the specified testing of the storm drainage system, or have an independent testing laboratory perform the testing.

B. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.
   1. Submit separate reports for each system inspection.
   2. Defects requiring correction include the following:
      a. Alignment: Less than full diameter of inside of pipe is visible between structures.
      b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
      c. Crushed, broken, cracked, or otherwise damaged piping.
      d. Infiltration: Water leakage into piping.
      e. Exfiltration: Water leakage from or around piping.
   3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
   4. Reinspect and repeat procedure until results are satisfactory.

C. Perform additional field tests on storm drainage which are required by the Town:
   1. It is the Contractor’s responsibility to ascertain the extent of additional testing required by the Town.
   2. If there is disagreement between standards as required by the Town and the Contract Documents, the stricter shall govern.

D. Complete testing within 10 working days after installation of storm drainage:
   1. If a section of storm drainage line is not to be installed until later in the construction schedule, the sections of storm drainage line installed shall be tested within 10 working days after completion, with the other sections tested after their installation.

E. Should the storm drainage pipe as installed fail to meet the requirements specified, the Contractor shall perform the necessary remedial work, including retesting, at no additional cost to the Owner.

3.06 CLEANING

A. Clean interior of piping and structures prior to the completion of the project. Cleaning includes new and existing piping and sumps of catch basins.

B. Maintain drainage outfalls in the same condition as at the start of construction throughout the construction operations. Clean drainage outfalls prior to the completion of the project.

END OF SECTION 33 41 00

SECTION 41 22 13

BRIDGE CRANE

PART 1 - GENERAL

1.01 SUMMARY

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 1 – GENERAL REQUIREMENTS, which are hereby made a part of this Section of the Specifications.

B. Section includes 10-ton top riding bridge crane.

1.02 RELATED SECTIONS

A. Section 13 34 19, PRE-ENGINEERED BUILDING.

B. Section 26 00 01, ELECTRICAL.

1.03 REFERENCES

A. American National Standards Institute (ANSI):
   1. B15.1 – Safety Standard for Mechanical Power Transmission Apparatus.
   2. B30.2 – Overhead and Gantry Cranes.
   3. B30.10 – Hooks.
   4. B30.19 – Cableways.
   5. HST-1M – Performance Standards for Electric Chain Hoists.
   6. HST-4M – Performance Standards for Overhead Electric Wire Rope Hoists.
   7. NOG-1 – Rules for Construction of Overhead and Gantry Cranes.
   8. NUM-1 – Rules for Construction of Cranes, Monorails, and Hoists.

B. American Welding Society (AWS):
   1. D1.1 – Structural Welding Code – Steel.
   2. D14.1 – Specifications for Welding Industrial and Mill Cranes.

C. NFPA 70 – National Electric Code.

D. Crane Manufacturer's Association of America: Specifications for Electric Overhead Traveling Cranes – CMAA Specification Number 70.

E. 29 CFR 1910, Subpart N, OSHA General Industry Standards, Materials Handling and Storage Subpart.

F. 29 CFR 1926, Subpart H, OSHA Construction Standards, Materials Handling, Storage, Use, and Disposal Subpart.

G. 29 CFR 1926, Subpart N, OSHA Construction Standards, Cranes, Derricks, Hoists, Elevators, and Conveyors Subpart.

H. American Institute of Steel Construction, The Manual of Steel Construction, latest edition.

1.04 PERFORMANCE REQUIREMENTS

A. Crane Capacity: The bridge crane and all associated components shall be rated for 10-ton (20,000 pound) capacity.

B. CMAA Rating Class C.

C. Vertical Impact: An impact allowance shall be included in design calculations for carriers (trolleys) and cranes. The impact shall be 0.5 percent of the rated load for each foot per minute of hoisting speed with a minimum allowance of 15 percent and a maximum of 50 percent.

1.05 SUBMITTALS

A. Submit in accordance with Section 01 33 00, SUBMITTALS.

B. Pre-Construction Submittals:
   1. Administrative Data: Submit name, address and telephone number of the local representative; a certification that the products specified have been in continuous and successful use for not less than 5 years; and general catalog information covering the characteristics of the system specified.
   2. Shop Drawings and Calculations: Submit all drawings required for the construction of the system. Shop drawings shall be to scale and fully dimensioned and shall provide sufficient detail to clearly indicate the arrangement of equipment and its components. The drawings shall show plan, elevation and sectional views along with all other pertinent data. Submit structural calculations for the bridge, signed by a registered engineer in the state of Massachusetts.
   3. Product Data: Submit technical product specification sheets for each system component and device which include all data needed to show compliance with this specification. Clearly indicate the exact model of each component to be provided.
   4. Mill Test Reports: Submit mill test reports for the bridge.
   5. Inspection and Rated Load Test Reports: Submit inspection reports and operational and rated load test reports in accordance with ANSI B30.2.

6. Manufacturer's Installation Instructions: Submit all components specified in this section.
7. Paint: Submit manufacturer's specification for each product, including product description, features, composition, special surface preparation procedure, substrate conditions requiring special attention, and recommended method of application. Include manufacturer's recommended dry mil thickness for each coat of each scheduled finish.
8. Manufacturer's Directions: Follow manufacturer's directions covering items not shown on the drawings or specified herein.

C. Pre-Commissioning Submittals:
   1. Operator's Manual: Submit for the specific crane furnished.
   2. Testing Procedure: Submit a testing procedure to be used to verify compliance.

D. Project Record Documents:
   1. Drawings shall be submitted by the Contractor which record the installed conditions. Show actual locations of all system components and affected equipment.
   2. Submit all electronic files including shop drawings, operator's manuals, and test procedures.
   3. Submit the crane certification documentation.

E. Operating and Maintenance Data:
   1. Include a project information sheet including project name and building location. Include names, address, and phone number of the service representative to be called in the event of equipment failure. Include a Statement of Guarantee including date of termination.
   2. Include operation and maintenance documentation for all equipment and devices, including the bridge, trolley, hoist, power and control circuit conductors, safety and control mechanisms, and all other parts and services define in this specification. Documentation shall include manufacturer's model number, manufacturer's installation instructions, frequency of inspection, recommended cleaning methods and materials, testing methods, and calibration tolerances. Advertising brochures shall not be used in lieu of the required technical manuals.
   3. The maintenance and operating manuals shall include key component breakaway pictures for ease of parts ordering, catalog cut pages, part numbers, and sub-assembly details.
   4. Include copies of all testing forms completed for this Project.

F. Warranty Period:
   1. Submit written reports on each service or inspection during the warranty period.
   2. During the warranty period, all copies of the drawings and manuals shall be updated to include all changes which were required to solve problems covered by the warranty.

1.06 QUALITY ASSURANCE

A. Qualifications:
   1. The manufacturer shall have a minimum of five years documented product development, testing, and manufacturing experience with the products specified in this Section.
   2. The installer shall have a minimum of five years documented experience applying the work of this Section.

1.07 PROJECT/SITE CONDITIONS

A. The Contractor shall field verify all site conditions. Notify the Architect immediately in writing of any site conditions which will prohibit the installation and operation of the bridge crane specified in this Section.

1.08 WARRANTY

A. Maintenance services shall be provided for one (1) year after final system acceptance. These services shall consist of manufacturer's factory-trained representative providing emergency repair service with on-site response within 24 hours of call, all test equipment and hardware necessary for maintenance and repair work and installation of any hardware modifications designed to improve system performance or eliminate know problems or deficiencies.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Acceptable Manufacturer's:
   1. Capco Crane & Hoist Inc., Rowley, MA 01969.
   2. American Crane & Equipment Corp., Douglassville, PA 19518.
   3. Or approved equal.

2.02 MATERIALS

A. Materials and equipment shall be uniform throughout the installation. All materials and equipment shall be new and shall be the standard products of manufacturers regularly engaged in the production of such equipment equal to or superior to the material specified and shall be the manufacturer's latest standard design that complies with the specification requirements.

2.03 BRIDGE GIRDERS

A. The center-to-center dimension of the runway rails shall be approximately 41’-3”. This dimension shall be field verified by the Contractor prior to manufacturing.

B. Bridge Girder:
   1. Bridge girders shall be constructed of A36 structural steel beams reinforced as necessary.
   2. Bridge girder to end truck connections are designed for loading, stresses, and stability in accordance with current CMAA design specification.
   3. Gusset and wing plate connections shall utilize high-strength A-325 bolts.
   4. Bridge girder track end stops shall be capable of withstanding the impact of a fully loaded trolley or carrier traveling at 50 percent of the full load speed.
   5. Bridge Weight: 11,500 pounds.

C. Bridge Drive:
   1. The bridge drive arrangement shall utilize am A-4 dual drive for positive traction.
   2. The gear motor assembly shall be flange mounted to each end truck with a final guarded open spur gear reduction at the bridge truck wheel.
   3. The bridge drive shall be controlled through a variable frequency drive from 2 to 80 feet per minute.

2.04 BRIDGE END TRUCKS AND WHEELS

A. Bridge Trucks:
   1. Bridge trucks shall be constructed of high-strength A500 structural tubing or welded structural shapes forming a rigid box section.
   2. Trucks shall be provided with rail sweeps and suitable bumpers designed to meet or exceed safety standards.

B. Wheels:
   1. Wheels shall be double flanged, and manufactured from high-strength cast spheroidal (nodular) iron.
   2. Wheel material shall be manufactured from 1045 steel hardened to 400-450 BHN.
   3. Wheels shall rotate on fixed axles with (2) bearings, seated against a machined shoulder.
   4. Bearings shall be single row ball type on 6” and 10” dia. wheels, and shall be sealed without need for periodic lubrication.
   5. 12” and 16” diameter wheels shall be furnished with precision tapered roller bearings and pressure lubricated fittings.
   6. Bearing life shall exceed CMAA for Class C for 5,000 hours, and Class D for 10,000 hours.

2.05 RAILS

A. Crane rails shall be of new 40# ASCE to support the crane loads. Rails complete with all rail, splices, end stops and attaching hook bolts to attach to the runway beams. See Section 13 34 19 PRE-ENGINEERED BUILDING for runway beams.

2.06 HOIST AND TROLLEY

A. The hoist and appurtenances shall be designed to withstand all stresses imposed under safe operating conditions while handling loads within the rated capacity. Load bearing parts shall be designed such that the static stress, calculated for rated load, shall not exceed 20 percent of the ultimate strength of the material.

B. All bearings shall be heavy duty, anti-friction type with a minimum B10 life of 5,000 hours. Motor bearings shall be lifetime lubricated, sealed ball bearings.

C. All gearing shall be forged heat treated alloy steel machined for smooth quiet operation. All gearing shall meet AGMA quality specifications. No cast gears will be permitted.

D. Bottom block shall be completely shrouded for safety and fabricated from steel. Sheaths shall be forged or rolled steel, running on anti-friction bearings. Hooks shall be forged steel supported by anti-friction thrust bearings and permit 360 degree rotation. A latch shall be provided to bridge the opening of the hook for the purpose of retaining slings, chains, etc., under slack conditions.

E. Motors shall be totally enclosed, specifically designed for hoist service capable of starting and operating under any condition within the designed capacity and provided with thermal overload protection.

F. The hoist shall incorporate an upper plugging type limit switch automatically stopping the hoist motion when the block reaches its highest position. Excessive hook drift shall cause the block to be momentarily reversed. An overload limit switch shall be set for 110% of rated capacity.

G. Electric hoist controls shall comply with NEC requirements for the application being considered and shall include control circuit breakers and contactors mechanically and electrically interlocked.

H. The hoist speed shall be have designed hook lift at 20/3.3 FPM two speeds with a 14.8 horsepower hoisting motor. Load hook provided with throat latch, and swivel bearings.

I. Hoist Brake: D.C. rectified disc type brake rated at 150% of the motors full load torque.

J. Trolley: 80 FPM variable speed, low headroom type trolley traverse drive located outboard of the trolley frame with a 1.2 horsepower trolley motor.

K. Trolley Wheels: 5.51" tread diameter machined hardened steel single flanged wheels mounted on axles with anti-friction bearings.

L. Hoist and Trolley Weight: 1,664 pounds.

2.07 MOTORS

A. All variable speed motors shall be squirrel cage type, totally enclosed. Motors shall be provided with lifetime lubricated anti-friction bearings, unless otherwise specified.

2.08 ELECTRICAL

A. Provide all materials, labor, and equipment and services necessary to provide a fully functioning and tested crane electrical system, complete with pendant.

B. Codes:
1. The electrical equipment shall meet NEMA Classification requirements for crane construction except where higher grade devices are specified.
2. The design and installation shall conform to the requirements of all applicable Massachusetts codes and regulations, and the National Electric Code NFPA 70.

C. Submittals:
1. Submit Bill of Materials, Manufacturer's Brochures and Catalog Cuts, Shop Drawings, Erection Drawings, Wiring Diagrams, Schematics, and an Equipment Layout.
2. Submit for approval all electrical controls, micro switches, wiring diagrams, schematics, control panels, identification labels, disconnect switches, wire, limit switches, enclosures, contactors, circuit breakers, pendants and buttons, collectors and shoes, motors, electric brakes, variable frequency drive (VFD), factory and field default settings for each VFD, and alarm devices.
3. Show location and elevation of all electrical controls and panels which shall be placed.

D. AC Controls:
1. The AC controls shall be provided with an under voltage device which will disconnect all motors from the line on failure of power or brownout and will not permit any motor to be restarted until a reset switch or push-button is operated.
2. All magnetic contactors shall be fully rated for their horsepower load and sized for continuous duty.

3. All crane components shall be designed for a 208V, 3 phase, 3 wire, 65 amp Delta system. The control voltage shall be 120VAC from a control power transformer with protective circuit breakers.
4. Bridge and runway conductors shall be Duct-O-Bar, Insul-8, or equal.
5. All control wiring shall be 120VAC, #14 minimum size, MTW or better in conduit or within panels.
6. All wiring shall be color coded and all terminal strips and wires shall be identified with markings.
7. All wiring between enclosures shall terminate on field wiring terminal strips at both ends, except where not practical at small field devices.
8. Limit switches shall be installed at both ends of travel on the trolley and the bridge to prevent the trolley or the bridge from striking the bumpers. The location of limit switches shall be adjustable. Use heavy-duty limit switches.
9. Furnish plastic name plates (to be secured with screws, not glue or double tack tape) with ¼" engraved lettering on the exterior of all controller enclosures with the appropriate markings, i.e. Main Disconnect, Main Line and Bridge Control, Trolley Control, Hoist Control etc. Within the enclosure all components including circuit breakers, contactors, relays, timers, terminal blocks, resistors, etc. shall be labeled with 1/8" engraved lettering, firmly attached with metal screws to the equipment.
10. All enclosures shall ne NEMA type 12, with removable hinged doors with neoprene gaskets, shall be in full compliance with National Electric Code for size, be readily accessible and doors shall be fully openable to 90 degrees.
11. A lockable crane disconnect switch shall be provided at floor level and shall be the Point of Connection for connection to the building power system. Disconnect switch shall be horsepower and heavy-duty rated.
12. A heavy-duty, horsepower rated, fused, disconnect switch shall be provided on the crane at the closest entry point that will shut off all power to the crane.

E. Brakes:
   1. Bridge and trolley shall have electrically operated fail safe magnetic disc type brakes for operation from a dedicated circuit breaker.
   2. Brakes shall be sized for the full load torque of the motor plus a safety factor. Provide bridge and trolley brake sizing calculations.

F. Pendant:
   1. All crane motions shall be controlled independently by a NEMA 4X pendant push-button station.
   2. The pendant push-button station shall have a power on light, twist on & push off switch; three step reversing buttons for infinitely variable bridge, trolley, and hoist VFD control; maintained pressure pendant raise and lower buttons, and a maintained pressure bypass switch.
   3. The pendant shall have complete control of all crane functions including turning power on and off, pendant up/down control, and bypass of trolley and bridge runway limit switches.

4. The pendant cable shall contain 8 spare conductors. The cable connector connecting the cable to the pendant shall support a minimum of 300 pounds.

G. Electrical Power:
1. Electrobar, or equal, inverted V-Bar, fully insulated and supported on insulators and brackets, shall be OSHA and UL approved. All conductors shall be individually enclosed with spring loaded collector shoes running on the underside. All wire attachments to the collectors shall be fully insulated, protected from harm, and securely attached.
2. All electrical wiring shall be in accordance with latest requirements of National Electric Code (NFPA 70) and OSHA standards. All wiring exterior to enclosures shall be in rigid steel conduit and bushings.
3. Electrical motor connections shall be liquid-tight flexible metal steel conduit with ground wire pulled within and bushings.
4. All wiring which interface the building power system shall meet the requirements of Division 26 00 01.

H. Electrical Testing:
1. Test Hoist, Trolley and Bridge VFD's under full load and no load conditions. Verify that temperature within VFD enclosures are still within tolerance after full load test.
2. Verify operation of all Pendant controls.
3. Verify operation of all limit switches. Verify operation of Bypass controls for limit switches.
4. Verify that electrical maintenance of all control enclosures can be performed.

I. Operating Manuals:
1. Submit three ring manuals which include As-Built schematics and wiring diagrams, Bill of Material, spare parts lists, replacement parts guides, lubricant and adjustment manuals, preventive maintenance guides, VFD programming.

J. Electrical As-Built Drawing:
1. At the completion of installation and after successful testing, Electrical As-Built drawings shall be provided containing all schematic, wiring and layout drawing information for the crane.

2.09 PAINTING

A. All painted surfaces shall receive proper metal preparation and cleaning prior to the paint coating system. A rust inhibiting prime coat shall be applied followed by a finish coat of industrial enamel.

B. Finish color shall be safety yellow for crane bridge, and blue for trolley unit. Color of trolley shall contrast against crane bridge for visual positioning.

PART 3 - EXECUTION

3.01 PREPARATION

A. Materials and equipment shall be protected against damage and rust during shipment.

3.02 SYSTEM MARKING

A. Major components of the system shall be marked at the factory so as to assure prompt and proper field identification.

3.03 CRANE ASSEMBLY AND TEST

A. Crane shall be factory assembled, and a no-load running test of controls and drive machinery performed to ensure proper operation. The crane shall be disassembled only as necessary for shipment.

3.04 PROTECTION OF EQUIPMENT

A. Care shall be exercised during construction to avoid damage or disfigurement of any kind. All equipment shall be protected from dust and moisture during construction.

3.05 EXAMINATION

A. Verify that building is ready to receive work.

3.06 CRANE INSTALLATION

A. Install the crane in accordance with manufacturer's instructions and approved shop drawings.

B. Touch-up any painted surfaces affected by installation of crane.

3.07 TESTING

A. Provide all labor and equipment necessary to perform a comprehensive acceptance test of the crane prior to the acceptance testing witnessed by the Owner's Representative. The Contractor shall complete the testing forms submitted and approved in the Pre-Commissioning Submittals. The Contractor shall submit to the

Architect three (3) copies of all test results, certifying in writing, witnessed, signed and dated, within 48 hours of completion of work.

B. Under the supervision of the Owner's Representative, the Contractor shall certify the performance of the crane. The Contractor shall contact the Architect to schedule certification at least two weeks prior to the date of certification testing.

C. The crane shall be certified in accordance with ANSI 830.2.0 and OSHA Title 29, Chapter 17, Part 1910.
   1. Safety: The crane certification testing shall be performed in accordance with the accepted Safety Plan for this project.
   2. Crane Inspection: Prior to load testing, the following shall be inspected to verify that they are operative and in like-new condition:
      a. Hoisting motors and brakes.
      b. Trolley travel and brakes.
      c. Bridge travel and brakes.
      d. Hoist limit switch.
      e. Steel hoisting ropes and hook.
   3. Holding Brake Load Test:
      a. Select a location for the load tests where a falling test load will not cause any damage of the brakes do not hold. The location should be convenient to make measurements of crane hook movements.
      b. If there is only one holding brake, the test load shall be 125 percent of the rated capacity of the hoist. Each holding brake shall be test loaded independently.
      c. The test load shall first be raised three inches off the load support to check the brake. The test load shall then be raised eighteen inches off the floor, the hoist stopped, and the load checked for downward drift. Record the downward drift of the test load after one minute of the holding brake being set. The test shall be performed twice for each holding brake.
      d. The test load shall then be raised thirty-six inches off the floor. The test load shall then be lowered eighteen inches at maximum lowering speed, the holding brake set, and the load checked for downward drift. Record the downward drift of the test load after one minute of the holding brake being set. This test shall be performed twice for each holding brake.
      e. If the test loads drifts downward more than ¼ inch within one minute of the holding brake being set during any of the tests, the holding brake shall be adjusted. The tests shall be repeated until the downward drift is less that ¼" within one minute of the holding brake being set, during all tests of the all holding brakes.
   4. Mechanical Load Brake Test:
      a. Select a location for the load tests where a falling test load will not cause any damage of the brakes do not hold. The location should be convenient to make measurements of crane hook movements.
      b. The test load for the mechanical load brake shall be 125 percent of the rated capacity of the hoist. Make the holding brakes inoperative.

c. The test load shall be raised three feet off the floor, the hoist stopped, and the load checked for downward drift. Record the downward drift of the test load after one minute of the hoist being stopped. The test shall be performed twice.
d. The test load shall then be raised five feet off the floor. The test load shall then be lowered two feet at maximum lowering speed, the hoist stopped, and the load checked for downward drift. Record the downward drift of the test load after one minute of the hoist being stopped. This test shall be performed twice.
e. If the test load drifts downward more than 12 inches within one minute of the hoist being stopped during any of the tests, the mechanical load brake shall be adjusted. The tests shall be repeated until the downward drift is less than 12 inches within one minute of the hoist being stopped, during all tests of the mechanical load brake.

5. Operational Tests:
   a. The test load for these tests shall be 75 percent of the rated capacity of the hoist.
   b. Raise and lower the test load. Verify the hoisting and lowering speeds of the hoist and verify the proper operation of the limit switch.
   c. Raise the test load three feet off the floor and move it transversely from side to side of the building. Verify the trolley travel speeds and stops on the bridge track rails.
   d. Raise the test load three feet off the floor and move it longitudinally from end to end of the building. Verify bridge travel speeds and stops on crane track rails.

D. The crane will not be accepted until all tests described in this section have been performed to satisfaction of the Architect. Any tests that cannot be performed due to circumstances beyond the control of the Contractor shall be exempt from the system acceptance requirements is stating as such in writing to the Architect. Such tests shall be performed as part of the crane warranty.

E. Any unsatisfactory condition revealed by these test results, or unsatisfactory methods of tests and/or testing apparatus and instruments, shall be corrected by the Contractor to the satisfaction of the Architect.

F. The Architect reserves the right to require the Contractor to perform and repeat any tests that are deemed necessary to complete or check the tests or the certified records of the Contractor at any time during the course of the work. The Contractor shall correct any unsatisfactory portion of the work that is revealed by the tests or that may be due to progressive deterioration during this period.

3.08 ELECTRICAL TESTING

A. Test Hoist, Trolley and Bridge VFD's under full load and no load conditions. Verify that temperature within VFD enclosures are still within tolerance after full load tests.

B. Verify operation of all Pendant controls.

C. Verify operation of all limit switches. Verify operation of Bypass controls for limit switches.

D. Verify that electrical maintenance for all control enclosures can be performed.

3.09 OPERATING MANUALS

A. Submit three ring manuals which include As-Built schematics and wiring diagrams, Bill of Material, spare parts lists, replacement parts guides, lubricant and adjustment manuals, preventive maintenance guides, VFD programming.

3.10 NOISE AND VIBRATION

A. Noise levels shall not exceed ASHRAE recommended noise criteria (NC) for a shop.

3.11 TRAINING

A. The Contractor shall provide 8 hours of training developed specifically for this project. The training sessions shall be given at the project site on a mutually agreed schedule. Manuals covering the training subject matter shall be submitted at least two weeks prior to training sessions. The instructor conducting the training sessions shall be fully proficient in the subject matter. The Owner reserves the right to cancel any training while in session, without loss of training time owed, if it feels that the instructor is not qualified in technical knowledge or ability to teach the subject matter. The training shall be in two sessions as follows:
   1. Session 1 – Four hours of training shall be provided prior to the proof-of-performance testing. The training shall focus on the overall system design, equipment functions, operation, and the Pre-Commissioning Substantial documentation.
   2. Session 2 – Four hours of training shall be provided following acceptance of the crane system. The training shall focus on the Project Records Documents and Operating and Maintenance Data.

END OF SECTION

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Memorandum

Date:	18 April 2019
To:	Gregg Yanchenko
Company:	Helene Karl Architects, Inc.
From:	Kayla Dooley/Richard Pizzi, P.E.
Project Name:	Montague Department of Public Works Facility
GCI Project:	#2194644
Subject:	Subsurface Investigation & Foundation Recommendations

This memorandum provides a summary of the subsurface conditions, as identified in the recently completed test pits, along with recommendations for foundation design and site preparation of the buildings and other structures planned for the new Department of Public Works (DPW) facility in the Turners Falls Village of Montague, Massachusetts.

Information used to prepare this report include:

- Drawing C-111 entitled "Site Development Plan" prepared by Helene Karl Architects, Inc. Dated 22 March 2019.

- Drawing G-1 entitled "Geotechnical Exploration Locations" prepared by Helene Karl Architects, Inc. dated revision 4 April 2019

- Survey drawing entitled "DPW Facility" provided by Helene Karl Architects, Inc.

Site Description
The proposed DPW site is located west of Turners Falls Road, just south of the intersection with Turnpike Road. It is roughly bounded by the existing Montague Police and Fire Stations to the north and Saint Mary's Cemetery to the south. Currently, the area of concern is heavily wooded with a mixture of mature trees and thick underbrush. Access to the site is available from the northern limits of the area of concern, at the rear of the present police station. Figure 1., *Locus Plan*, shows the general site vicinity and Figure 2., *Ortho Photo Map*, illustrates the site limits and existing buildings.

Site grades slope nearly uniformly and gently downward from the high point at elevation 110+ located within the proposed footprint area of the building to the low elevations of 98± feet at both the northwest and southwest corners of the area of concern. Within the proposed building footprint, the existing ground surface ranges between elevation 110+ and 101± feet.

Existing underground utilities include municipal water and sewer services located at the eastern property boundary.

The proposed DPW facility will include the primary building, ancillary structures, paved parking areas and primary access driveway. Vehicle access will be from Turners Falls Road along the primary driveway postioned to the northeast of the main building.

Structure	Footprint Area
Vehicle Storage and Repair Building:	27,000 square feet
Salt Shed:	4,500 square feet
Material Shed:	2,400 square feet
Stockyard:	8,400 square feet

The finished floor at the primary DPW building will be set at elevation 107.0 feet.

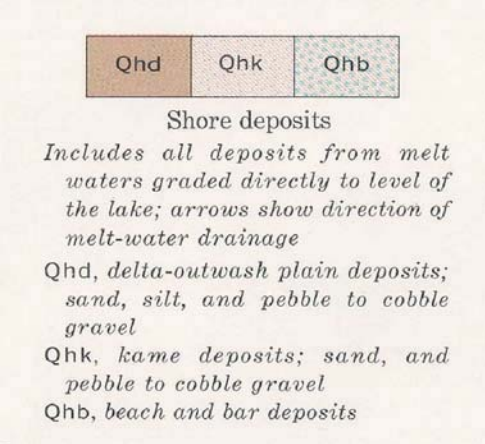
In addition to the site structures, site drainage improvements include construction of a detention pond located to the north of the proposed main access driveway. Currently, this area is used by the Montague Police Department for canine training.

Subsurface Investigation

A subsurface investigation, consisting of eleven (11) test pits, was conducted in April 2019. All excavations were made by the Town of Montague Department of Public Works using a Komatsu WB156 excavator. Test pit locations were established in the field using a Sub-Meter GPS. Coordinates at each test pit are referenced to the Massachusetts State Plane coordinate system. The conditions exposed at each test pit were observed and logged for geotechnical engineering purposes by a Project Engineer from Geotechnical Consultants, Inc. Test pits logs prepared by Geotechnical Consultants, Inc. are included in Appendix A. and the approximate position of each test pit is shown on the *Location Plan*.

In addition to the logs prepared by Geotechnical Consultants, Inc. the conditions were logged at the test pits located outside the proposed building area by a licensed soil evaluator under subcontract to Geotechnical Consultants, Inc. The logs were recorded on the Commonwealth of Massachusetts Form 11. Information provided by the soil evaluator, including the Form 11 logs, are included in Appendix B.

General information regarding the surficial sediments for the project location is shown on the *Locus Plan.* The *Locus Plan* was taken from the surficial geology map entitled *Surficial Geologic Map of the Greenfield Quadrangle for Franklin County, MA.* A portion of the map legend is provided which identifies the relevant site landform.



In general, the test pits revealed the following strata within the depth explored:

- ***Topsoil :*** The topsoil layer consists of dark brown/black sandy LOAM containing roots. Where encountered, this layer varies from about 4-inches± to 1± foot thick.

- ***Subsoil:*** Granular fill soils containing varying proportions of brown to orange medium to fine sand. The depth of the subsoil layer at the test pit locations range between 2.5± and 3.7± feet below present ground surface.

- ***Natural Sand:*** The underlying natural sand layer consists of uniformly graded light brown medium to fine sand with very minor amounts of coarse sand and only trace amounts of silt.

Test pits TP-3 and TP-4 were excavated within the proposed detention basin. Within this area, the site is underlain by 1± to 2± feet of granular fill. At test pit location TP-4, a 4-inch thick layer of dark sandy loam, most likely the original topsoil layer, was found below the fill.

With the exception of TP-3 and TP-4, no groundwater was encountered, to the depths explored, within any of the test pit excavations. At TP-3 and TP-4 groundwater was observed at depths of 8 feet and 9 feet, respectively. Fluctuations in groundwater levels should be expected and are influenced by seasonal variations, precipitation, site features, nearby construction activities and other environmental factors.

Foundation Design Recommendations

It is recommended the DPW facility buildings, including the Vehicle Storage and Repair Building, Salt Shed and Material Shed, be founded on conventional spread footings with a cast-in-place concrete slab-on-grade floors where appropriate. It is recommended that the proposed stockyard be founded on a cast-in-place concrete pad. Some site preparation will be required to properly maintain the proposed finished floor grade.

Spread Footings

Conventional spread footing foundations can be sized for an allowable contact pressure of up to two tons per square foot (4,000 psf). For lightly loaded walls and isolated columns, minimum dimensions of 2-feet wide for strip footings and 3-feet square for column footings should be maintained.

Exterior footings and interior footings within unheated spaces must be placed to at least the local frost depth. Although not specifically stated in the current *Massachusetts State Building Code*, it is recommended the historical local minium frost depth of 4 feet be maintained.

Floor Slab Recommendations

The floor slab can be designed as a cast-in-place concrete slab-on-grade. In order to limit cracking of the floor slab, consider reinforcing the slab. Slab thickness and reinforcement can be determined based on a modulus of subgrade reaction of 200 pci using either the PCA or WRI method.

All slabs-on-grade should be supported on a 12-inch thick "gravel" subbase. Material used for the subbase should meet the gradation limits and compaction requirements presented below for imported structural backfill.

Although vapor barriers may aggravate problems associated with plastic shrinkage and cracking, we recommend placing a vapor barrier directly below the slab in areas which will receive finishes such tile or glued carpeting or other moisture sensitive coatings. The vapor barrier should consist of a Stego® Wrap Vapor Barrier by Stego Industries LLC, or equal, with a water vapor transmission rate of 0.3 perms or lower in accordance with ASTM E 96. Seams should be sealed in accordance with the manufacture's recommendation.

Seismic Site Considerations

The following seismic site class and spectral response were determined in accordance with the 9th Edition *Massachusetts State Building Code*. The recommended site class presumes the site is prepared as described below.

Seismic Site Class D - Stiff Soil Profile

Spectral Response Acceleration at short period, S_s (Table 1604.11):	0.173g
Spectral Response Acceleration at 1 sec., S_1 (Table 1604.11):	0.068g
Site Coefficient, F_a (Table 1613.3.3(1)):	1.6
Site Coefficient, F_v (Table 1613.3.3(2)):	2.4
Adjusted spectral response, S_{Ms} (Equation 16-36):	0.277g
Adjusted spectral response, S_{M1} (Equation 16-37):	0.163g

Liquefaction refers to the loss of strength in saturated cohesionless soils due to the build up of pore water pressures during cyclic or seismic loading. The soils at this site are not susceptible to

liquefaction.

Stockyard Equipment Pads

Equipment pads within the proposed stockyard can be constructed using cast-in-place concrete. Although the frost depth for building foundations must be set at a prescribed depth, local practice allows for the placement of equipment pads to shallower depths. Each pad should be at least 12-inches thick, reinforced for temperature and shrinkage and supported directly on a layer of non-frost susceptible ¾inch crushed stone meeting the requirements of the Massachusetts DOT Specifications M2.01.4.

Site preparation at the equipment pads should follow the recommendations for preparation of the building areas provided below.

Pavement and Parking Areas

Flexible pavement design for standard and heavy duty pavement sections are based on the AASHTO *Guide for Design of Pavement Structures*. The thickness of each course depends on subgrade strength, traffic, design life, serviceability factors and frost susceptibility. Reference is made to the Commonwealth of Massachusetts Department of Public Works (MADPW) specifications for Bridge and Highway construction, 1988 edition.

In all paved areas, the subgrade should be heavily proofrolled using at least four passes of a 20-ton vibratory roller operating at maximum amplitude. Where fill is required to attain the desired grade, the ordinary fill should consist of predominately clean granular soil with no heavy concentration of decayable matter or other deleterious material. The fill should be placed in lifts not exceeding 12 inches (loose measure) and should be compacted to at least 92% modified Proctor density. Adequate precautions to protect the subgrade, as described above, must be implemented.

The following materials should be used to construct the pavement sections:

	Thickness (inches)	
Pavement Material	Standard Duty	Heavy Duty
Bituminous Concrete Top Course, MA DPW M3.11.03 Table A	1.0	1.0
Bituminous Concrete Binder Course, MA DPW M3.11.03 Table A	2.0	3.0
Processed Gravel for Subbase Course MA DPW M1.03.1	8.0	12.0

The Processed Gravel must consist of inert material that is hard, durable stone and coarse sand, free from loam and clay, surface coatings and other deleterious materials. The coarse aggregate

should have a percentage of wear of not more than 50 when tested by the LA Abrasion Test. Gradation limits for Processed Gravel subbase course must meet the following requirements:

Sieve Size	Percent Passing
3"	100
1½"	70-100
¾"	50-85
No. 4	30-60
No. 200	0-10

Subbase course must be compacted to at least 95 percent of the maximum dry density as determined by the Proctor Test (AASHTO T-99). Bituminous concrete must be placed at the specified temperature range and compacted to at least 95 percent of the Marshall Density for the job mix formula.

It is recommended that the standard duty section, as provided above, be constructed in parking and lightly traveled areas. The heavy duty pavement section should be constructed at primary drives, delivery areas, and other areas subjected to heavy car or truck traffic. Positive site drainage must be provided in all paved areas.

Site Preparation

In all areas requiring load support, including but not limited to building areas, equipment pads, parking areas and the primary driveway, all loam and topsoil must be removed. Based on the measurements at the test pits, the topsoil/loam is expected to vary in thickness between 4-inches and 12-inches. Loam and topsoil may be stockpiled and re-used in landscaped areas provided it meets the specified requirements for plantings. **Local variations in the depth, nature and character of the materials to be removed are likely to occur within the work area**.

After removing the surficial cover and previously placed fill, it is recommended the exposed subgrade be proof compacted using a vibratory drum roller or plate compactor with a rated dynamic weight of at least 2 tons. In order to maximize the vibratory densification process, proof-compacting should be performed with the roller operating at maximum amplitude.

Given the existing high point grade at elevation 110.0+ feet and the proposed finished floor grade at elevation 107.0 feet, the high portions of the building footprint area will be located in cut sections, but the majority of the building area will require fill. All fill placed within the building footprint areas must be placed as structural fill.

The sand which will be cut from the higher levels of the site or from other site excavations consists of clean uniformly graded medium to fine sand. This material, in its present state, can not be used as structural backfill. If necessary, the on-site soils may be blended with coarse

aggregate to produce a well-graded mixture suitable for placement as structural backfill.

Imported material used for structural backfill should consist of clean well-graded granular soil or other dense processed aggregate with gradation limits as follows and have no stones larger than 3" (three inches):

Sieve Size	Percent Passing
3"	100
½"	50-85
No. 4	40-75
No. 50	8-28
No. 200	0-8

The material used as structural backfill must be free of organic material, loam, snow, ice, frozen soil and other objectionable material. All structural fill should be placed in 12-inch loose lifts and compacted to a modified Proctor density of 95 percent (ASTM D1557). Prior to construction, a sample of the proposed structural fill material should be obtained directly from the source location and tested to assure proper gradation and verify the material is free from oil or hazardous material as defined by the *Massachusetts Contingency Plan* (MCP).

Excavation for footings and exposed subgrade should be inspected by a qualified geotechnical engineer to ensure adequacy of the subgrade soils. The placement of all structural backfill must be inspected and certified as to its adequacy in compliance with the *Massachusetts State Building Code*.

Backfill soil placed outside the building footprint in areas of non-load support may be “ordinary fill”. Ordinary fill should consist of granular soil containing no decayable matter such as roots, wood, organic soil, etc. Ordinary fill should be placed in layers and compacted with available construction equipment to reduce future settlement.

Subgrade Maintenance and Protection

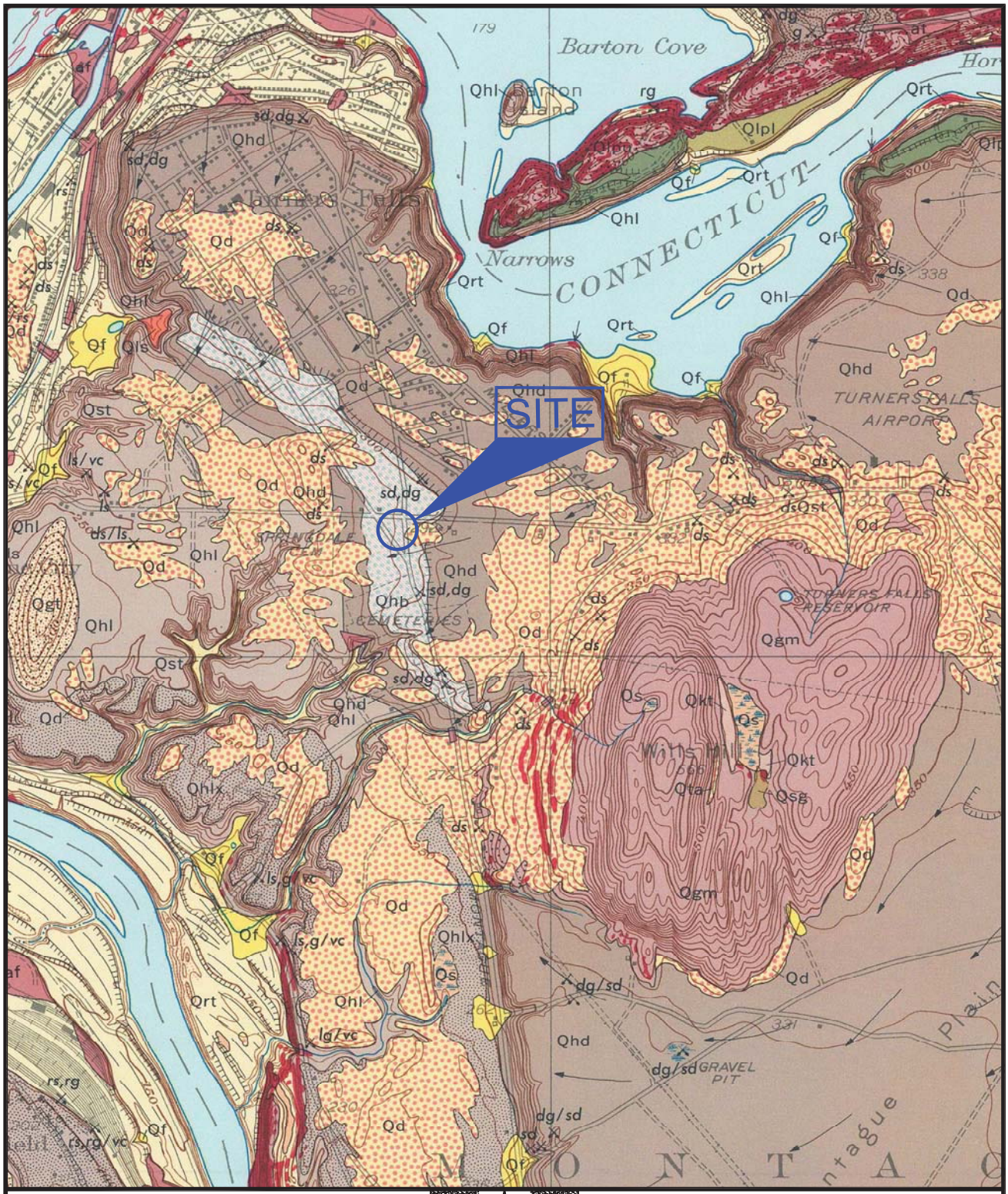
Although groundwater is not anticipated, dewatering may be required during construction due to precipitation and runoff. Adequate site drainage must be provided to preclude the accumulation of surface water within the building footprint areas as well as the paved parking lot and access roadway. Drainage or dewatering, where needed, must be done so that all work can proceed in-the-dry.

Additionally, it is imperative that all exposed subgrade soils be protected from prolonged exposure to freezing temperatures.

Limitations

This memorandum has been prepared for the proposed DPW Facility building addition located on Turner Falls Road in Montague, Massachusetts in accordance with generally accepted practices. No other warranty, expressed or implied, is made. Conclusions and recommendations made herein are based upon data obtained from widely spaced subsurface explorations. The nature and extent of variations between these explorations may not become evident until further explorations are conducted or during construction. If variations or other conditions are encountered at a later time, it may be necessary to re-evaluate any conclusion or recommendation of this report. Additionally, as the design development progresses and details of the proposed construction are finalized, some changes to these recommendations may be warranted.

It has been our pleasure serving you. Should you have any questions concerning the recommendations presented herein, please do not hesitate to contact us.



Montague D.P.W.
Turners Falls Road
Montague, Massachusetts

LOCUS PLAN
SURFICIAL GEOLOGIC MAP OF THE
GREENFIELD QUADRANGLE
FRANKLIN COUNTY, MA
APPROX. SCALE 1:24 000

Geotechnical
Consultants, Inc.

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GCI Project # 2194644

Figure 1.

Montague Department of Public Works
Montague, Massachusetts
GCI Project No. 2194644

Figure 2.
Color Orthophoto Map

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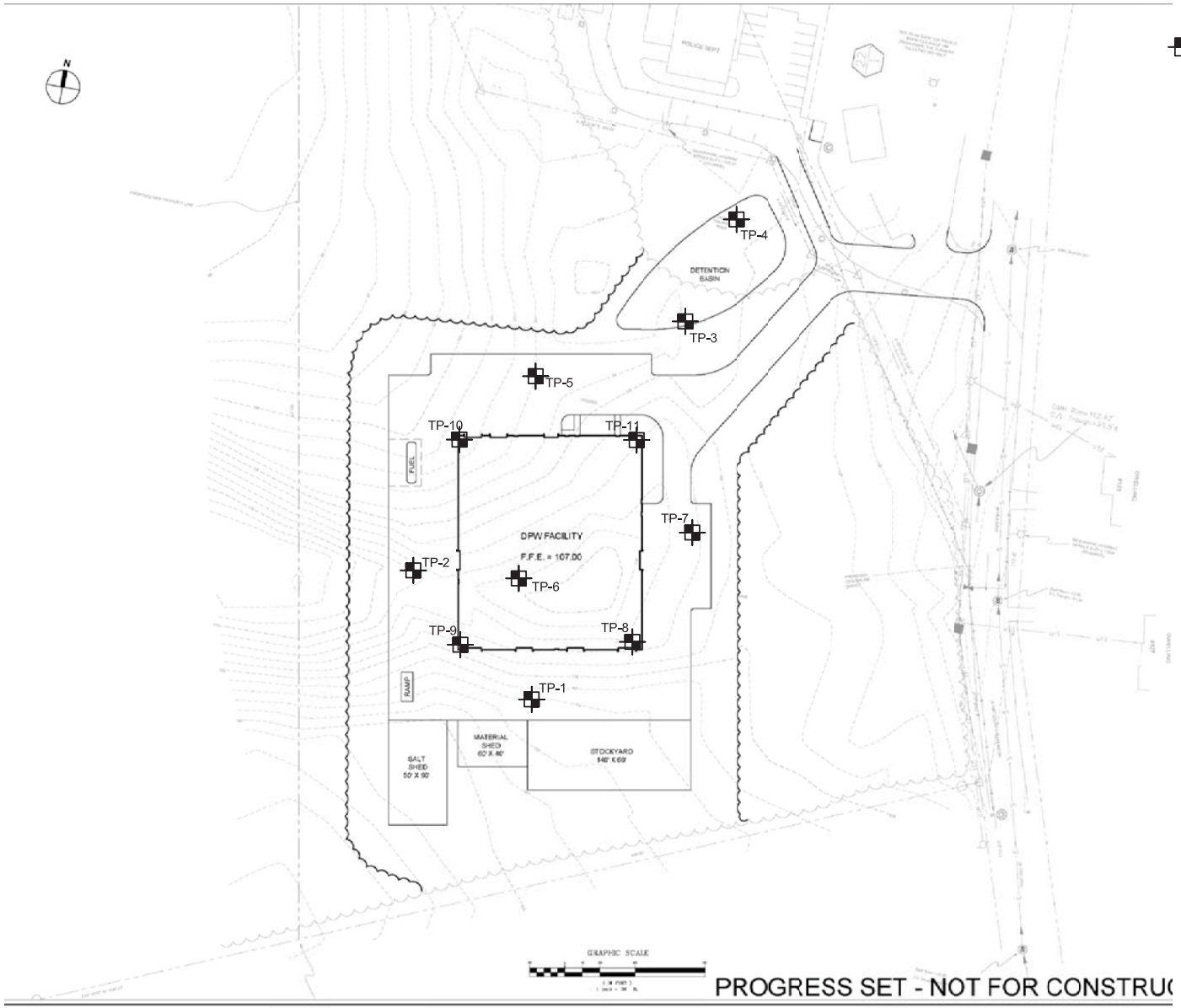

LEGEND

APPROXIMATE LOCATION OF TEST PITS DONE BY THE TOWN OF MONTAGUE DEPARTMENT OF PUBLIC WORKS AND LOGGED BY GEOTECHNICAL CONSULTANTS, INC. IN APRIL 2019.

BASE PLAN TAKEN FROM ELECTRONIC COPY OF DRAWING G–1 ENTITLED "GEOTECHNICAL EXPLORATION LOCATIONS" PREPARED BY HELENE KARL ARCHITECTS, INC. DATED REVISION 4 APRIL 2019.

GCI Project No. 2164644

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LOCATION PLAN

SCALE: AS SHOWN

APRIL 2019

TURNERS FALLS ROAD,
TURNERS FALLS VILLAGE
MONTAGUE, MASSACHUSETTS

Figure 3.

APPENDIX A

TEST PIT LOGS

LOG OF TEST PITS

Project:	Town of Montague Department of Public Works Facility	**Date:**	9-Apr-19
Location:	Montague, Massachusetts	**Weather:**	40's/Overcast
		Designation:	**TP 1**
STRATUM (ft.)	**Description**	**GCI Job #:**	2194644
From: To:		**Surface El.**	103.0± feet

From:	To:	Description
0	0.3'	TOPSOIL: Dark brown, sandy loam containing roots.
0.3'	3'	Brown to orange SUBSOIL, fine sand, trace medium sand, trace organic fines, roots.
3'	7.5'	Light brown, fine SAND, trace medium sand.
		End of test pit at ~7.5 feet.

Water Level: No water encountered upon completion of the test pit.

Remarks:

EQUIPMENT: Komatsu WB-156

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LOG OF TEST PITS

Project:	Town of Montague Department of Public Works Facility	**Date:**	9-Apr-19
Location:	Montague, Massachusetts	**Weather:**	40's/Overcast
		Designation:	**TP 2**
STRATUM (ft.)	**Description**	**GCI Job #:**	2194644
From: / To:		**Surface El.**	109.5± feet

From:	To:	
0	0.3'	TOPSOIL: Dark brown, sandy loam containing roots.
0.3'	2.5'	Brown to orange SUBSOIL, fine sand, trace medium sand, trace organic fines, roots.
2.5'	8'	Light brown, fine SAND, trace medium sand.
		End of test pit at ~8' feet.

Water Level: No water encountered upon completion of the test pit.

Remarks:

EQUIPMENT: Komatsu WB-156

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Tel: (508)229-0900 FAX: (508)229-0900
www.geotechnical.us

LOG OF TEST PITS

Project:	Town of Montague Department of Public Works Facility	**Date:**	9-Apr-19
Location:	Montague, Massachusetts	**Weather:**	40's/Overcast
		Designation:	**TP 3**
STRATUM (ft.)	**Description**	**GCI Job #:**	2194644
From: / To:		**Surface El.**	104.0± feet

From:	To:	
0	1'	FILL: Dark brown, coarse to fine sand, some coarse to fine gravel, little silt, trace organic fines.
1'	2.5'	Brown to orange SUBSOIL, fine sand, trace medium sand, trace organic fines, roots.
2.5'	8'	Light brown, fine SAND, trace medium sand.
8'	8.5'	Gray, SILT, some fine sand.
		End of test pit at ~8.5 feet.

Water Level: Water seeping into excavation at 8 feet below ground surface.

Remarks:

EQUIPMENT: Komatsu WB-156

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Marlborough, Massachusetts 01752
Tel: (508)229-0900 FAX: (508)229-0900
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LOG OF TEST PITS

Project:	Town of Montague Department of Public Works Facility	**Date:**	9-Apr-19
Location:	Montague, Massachusetts	**Weather:**	40's/Overcast
		Designation:	**TP 4**
STRATUM (ft.)	**Description**	**GCI Job #:**	2194644
From: / To:		**Surface El.**	104.5± feet

From:	To:	
0	2'	FILL: Dark brown, coarse to fine sand, some coarse to fine gravel, little silt, trace organic fines, mulch.
2'	2.5'	Brown, sandy loam containing roots.
2.5'	3.7'	Brown to orange SUBSOIL, fine sand, trace medium sand, trace organic fines, roots.
3.7'	9'	Light brown, fine SAND, trace medium sand.
9'	9.5'	Gray SILT, some fine sand.
		End of test pit at ~9.5'

Water Level: Water seeping into excavation at 9 feet below ground surface.

Remarks:

EQUIPMENT: Komatsu WB-156

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LOG OF TEST PITS

Project:	Town of Montague Department of Public Works Facility	**Date:**	9-Apr-19
Location:	Montague, Massachusetts	**Weather:**	40's/Overcast
		Designation:	**TP 5**
STRATUM (ft.)	**Description**	**GCI Job #:**	2194644
From: To:		**Surface El.**	103.0± feet

From:	To:	
0	1'	TOPSOIL: Dark brown, sandy loam containing roots.
1'	2.5'	Brown to orange SUBSOIL, fine sand, trace medium sand, trace organic fines, roots.
2.5'	7'	Light brown, fine SAND, trace medium sand.
		End of test pit at ~7 feet.

Water Level: No water encountered upon completion of the test pit.

Remarks:

EQUIPMENT: Komatsu WB-156

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Tel: (508)229-0900 FAX: (508)229-0900
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LOG OF TEST PITS

Project:	Town of Montague Department of Public Works Facility	**Date:**	9-Apr-19
Location:	Montague, Massachusetts	**Weather:**	40's/Overcast
		Designation:	**TP 6**
STRATUM (ft.)	**Description**	**GCI Job #:**	2194644
From: To:		**Surface El.**	109.0± feet

From:	To:	
0	1'	TOPSOIL: Dark brown, sandy loam containing roots.
1'	2.5'	Brown to orange SUBSOIL, fine sand, trace medium sand, trace organic fines, roots.
2.5'	9'	Light brown, fine SAND, trace medium sand.
		End of test pit at ~9 feet.

Water Level: No water encountered upon completion of the test pit.

Remarks:

EQUIPMENT: Komatsu WB-156

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LOG OF TEST PITS

Project:	Town of Montague Department of Public Works Facility	**Date:**	9-Apr-19
Location:	Montague, Massachusetts	**Weather:**	40's/Overcast
		Designation:	**TP 7**
STRATUM (ft.)	**Description**	**GCI Job #:**	2194644
From: To:		**Surface El.**	107.0± feet

From:	To:	
0	1'	TOPSOIL: Dark brown, sandy loam containing roots.
1'	2.5'	Brown to orange SUBSOIL, fine sand, trace medium sand, trace organic fines, roots.
2.5'	9'	Light brown, fine SAND, trace medium sand.
		End of test pit at ~9 feet.

Water Level: No water encountered upon completion of the test pit.

Remarks:

EQUIPMENT: Komatsu WB-156

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Tel: (508)229-0900 FAX: (508)229-0900
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LOG OF TEST PITS

Project:	Town of Montague Department of Public Works Facility	**Date:**	17-Apr-19
Location:	Montague, Massachusetts	**Weather:**	40's/Sunny
		Designation:	**TP 8**
STRATUM (ft.)	**Description**	**GCI Job #:**	2194644
From: / To:		**Surface El.**	107.5± feet

From:	To:	
0	0.3'	TOPSOIL: Dark brown, sandy loam containing roots.
0.3'	3'	Brown to orange SUBSOIL, fine sand, trace medium sand, trace organic fines, roots.
3'	8'	Light brown, fine SAND, trace medium sand.
		End of test pit at ~8' feet.

Water Level: No water encountered upon completion of the test pit.

Remarks:

EQUIPMENT: Komatsu WB-156

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Tel: (508)229-0900 FAX: (508)229-0900
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LOG OF TEST PITS

Project:	Town of Montague Department of Public Works Facility	**Date:**	17-Apr-19
Location:	Montague, Massachusetts	**Weather:**	40's/Sunny
		Designation:	**TP 9**
STRATUM (ft.)	**Description**	**GCI Job #:**	2194644
From: To:		**Surface El.**	106.0± feet

From:	To:	
0	0.5'	TOPSOIL: Dark brown, sandy loam containing roots.
0.5'	3'	Brown to orange SUBSOIL, fine sand, trace medium sand, trace organic fines, roots.
3'	9'	Light brown, fine SAND, trace medium sand.
		End of test pit at ~9' feet.

Water Level: No water encountered upon completion of the test pit.

Remarks:

EQUIPMENT: Komatsu WB-156

Geotechnical Consultants, Inc.
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Tel: (508)229-0900 FAX: (508)229-0900
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LOG OF TEST PITS

Project:	Town of Montague Department of Public Works Facility	**Date:**	17-Apr-19
Location:	Montague, Massachusetts	**Weather:**	40's/Sunny
		Designation:	**TP 10**
STRATUM (ft.)	**Description**	**GCI Job #:**	2194644
From: To:		**Surface El.**	102.0± feet

From:	To:	Description
0	0.5'	TOPSOIL: Dark brown, sandy loam containing roots.
0.5'	3'	Brown to orange SUBSOIL, fine sand, trace medium sand, trace organic fines, roots.
3'	7.5'	Light brown, fine SAND, trace medium sand.
		End of test pit at ~7.5' feet.

Water Level: No water encountered upon completion of the test pit.

Remarks:

EQUIPMENT: Komatsu WB-156

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LOG OF TEST PITS

Project:	Town of Montague Department of Public Works Facility	**Date:**	17-Apr-19
Location:	Montague, Massachusetts	**Weather:**	40's/Sunny
		Designation:	**TP 11**
STRATUM (ft.)	**Description**	**GCI Job #:**	2194644
From: To:		**Surface El.**	107.0± feet

From:	To:	Description
0	0.3'	TOPSOIL: Dark brown, sandy loam containing roots.
0.3'	3'	Brown to orange SUBSOIL, fine sand, trace medium sand, trace organic fines, roots.
3'	9'	Light brown, fine SAND, trace medium sand.
		End of test pit at ~9' feet.

Water Level: No water encountered upon completion of the test pit.

Remarks:

EQUIPMENT: Komatsu WB-156

Geotechnical Consultants, Inc.
201 Boston Post Road West
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Tel: (508)229-0900 FAX: (508)229-0900
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APPENDIX B

SOIL EVALUATION

ALTON ENGINEERING
Hydrology - Water Resources – Environmental – Site Design & Permitting – Wetland Sciences

Alton Day Stone, PE, LSP, ASE
Registered Professional Engineer, Licensed Site Professional, Approved Soil Evaluator
10 Rugg Road, Sterling, MA 01564
Phone: 978.660.7728 Email: altonengineering@gmail.com

April 17, 2019

Mr. Richard Pizzi, PE
Geotechnical Consultants, Inc.
201 Boston Post Road West
Marlborough, MA 01752

RE: Soil Evaluation – Proposed New DPW Building
One Avenue A, Turners Falls, Montague, MA

Dear Mr. Pizzi, PE:

This letter report documents two soil evaluations completed by Alton Engineering at the site of the proposed new Department of Public Works building. The evaluations were completed on April 9, 2019 pursuant to your request. Soil evaluations were completed for test pits TP3 and TP4 for the purpose of evaluating soil for stormwater infiltration capability. The test pit locations were designated by others at the location of a proposed stormwater retention and infiltration basin. Title 5 Logs are attached.

Soil at the basin location is identified on the NRCS Soils Website as Windsor Loamy Sand (soils map attached). Surficial geologic data indicates the soil consists of lacustrine plane sediment overlain by coarser outwash plane sediment. These designations are commensurate with soil observed in the two test pits.

Until recently the location of the test pits was an area of white pine forest connected to the larger forest situated to the southeast. However, a severe wind storm toppled many of the trees. The area subsequently was cleared, stumped and grubbed. A mixed fill consisting of earth and organic materials - e.g. sand, silty/clay sand, bark chips and mulch – was placed, leveled and seeded such that the area now is grass lawn.

<u>Generalized Soil Profile</u>
Mixed earth and organic fill layer to depths of between 12 and 24 inches.
Buried A Horizon (identified in TP4) to 30 inches. Loamy Sand.
Bw Horizon. Loamy Sand to between 30 and 44.
C1 Layer. Sand to 102 inches at which water weeping into both pits and prominent redoxymorphic bands of orange to red concentrations were observed.

C2 Layer. Varved Layers of depleted (low chroma) clay-silt-fine-sand loam interspersed with loamy sand to 108 inches (bottom of hole).

Seasonal high water level is estimated to be 102 inches. Excluding the fill and buried A Horizon the profile provides 7± feet of naturally occurring pervious material. Rawls Infiltration Rates are: Sand 8.27 inches/hour, Loamy Sand 2.41 inches/hour. Therefore, the basin location appears to be well suited for retention and infiltration.

Yours truly,
ALTON ENGINEERING

Alton Day Stone, PE, ASE
Approved Soil Evaluator SE2931

Attachments: Form 11.
NRC Soils Map and Unit Description
MassGIS Map

Commonwealth of Massachusetts
City/Town of Montague

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

A. Facility Information

Town of Montague, MA - Department of Public Works
Owner Name

180 Turnpike Road
Street Address

Map 22 - Block 0 - Lot 01
Map/Lot #

Montague
City

MA
State

01351
Zip Code

B. Site Information

1. (Check one) ☒ New Construction ☐ Upgrade ☐ Repair

2. Soil Survey Available? ☒ Yes ☐ No If yes: NRCS Website (Source) 255A (2svkg Nation Map) (Soil Map Unit)

   Windsor Loamy Sand (Soil Name) None (Soil Limitations)

   Outwash Sand over Lacustrine F-Sand, Silt, Clay Outwash Plane over Lacustrine Plane (Landform)

3. Surficial Geological Report Available? ☒ Yes ☐ No If yes: 8/31/2010 (Year Published/Source) Coarse Stratified (Map Unit)

   Stratified Sands and Gravels
   Description of Geologic Map Unit:

4. Flood Rate Insurance Map Within a regulatory floodway? ☐ Yes ☒ No

5. Within a velocity zone? ☐ Yes ☒ No

6. Within a Mapped Wetland Area? ☐ Yes ☒ No If yes, MassGIS Wetland Data Layer: (Wetland Type)

7. Current Water Resource Conditions (USGS): 04/09/2019 (Month/Day/ Year) Range: ☐ Above Normal ☒ Normal ☐ Below Normal

8. Other references reviewed: Mass GIS Website - Stratified Drift

   USGS Websites - Groundater Data, and Surficial Geology Compiliations

Commonwealth of Massachusetts
City/Town of Montague

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (*minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: TP1 (Hole #) | 4/9/19 (Date) | 10:00am (Time) | Overcast (Weather) | 42.586701 (Latitude) | -72.55094 (Longitude:)

1. Land Use: Forest (e.g., woodland, agricultural field, vacant lot, etc.) | Eastern White Pine Trees (Vegetation) | None (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | 0-3% (Slope (%))

Description of Location: Wooded area south of police station

2. Soil Parent Material: Outwash | Outwash Plane over Lacustrine Plane | TS (Position on Landscape (SU, SH, BS, FS, TS))

3. Distances from: Open Water Body >100 feet | Drainage Way >100 feet | Wetlands >100 feet | Property Line >200 feet | Drinking Water Well >100 feet | Other _____ feet

4. Unsuitable Materials Present: ☐ Yes ☒ No If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☐ Yes ☒ No If yes: _____ Depth Weeping from Pit _____ Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-4	A	Silt Loam	10YR 2/1	-	-	-	<1	<1	Single Grain	V. Friable	Topsoil
4-36	B	Loamy Sand	10YR 5/6	-	-	-	<1	<1	Single Grain	Loose	Subsoil
36-90 BOH	C	Sand	2.5Y 6/3	-	-	-	<1	<1	Single Grain	Loose	Natural Sand

Additional Notes:

Commonwealth of Massachusetts
City/Town of Montague

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (*minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: TP2 (Hole #) | 4/9/19 (Date) | 10:20 AM (Time) | Overcast (Weather) | 42.586849 (Latitude) | -72.550192 (Longitude:)

1. Land Use: Forest (e.g., woodland, agricultural field, vacant lot, etc.) | Eastern White Pine Trees (Vegetation) | None (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | 3-8 % (Slope (%))

Description of Location: Wooded area south of Police Station

2. Soil Parent Material: Outwash | Outwash Plane over Lacustrine Plane (Landform) | TS (Position on Landscape (SU, SH, BS, FS, TS))

3. Distances from: Open Water Body >100 feet | Drainage Way >100 feet | Wetlands >100 feet
Property Line 100+/- feet | Drinking Water Well >100 feet | Other _____ feet

4. Unsuitable Materials Present: ☐ Yes ☒ No If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☐ Yes ☒ No If yes: _____ Depth Weeping from Pit _____ Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA)	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-4	A	Sandy loam	10YR 2/1	-	-	-	<1	<1	Single Grain	V.Friable	Topsoil
4-30	B	Loamy Sand	10YR 5/6	-	-	-	<1	<1	Single Grain	Loose	Subsoil
30-90 BOH	C	Sand	2.5Y 6/3	-	-	-	<1	<1	Single Grain	Loose	Natural Sand

Commonwealth of Massachusetts
City/Town of Montague

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (*minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: TP3 (Hole #) | 4/9/19 (Date) | 10:30 (Time) | Overcast (Weather) | 42.58904 (Latitude) | 72.54883 (Longitude:)

1. Land Use: Vacant - former forest, now grass over fill layer | Grass (Vegetation) | None (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | 0 - 1% (Slope (%))

Description of Location:

2. Soil Parent Material: Outwash | Outwash Plane over Lacustrine Plane | TS (Position on Landscape (SU, SH, BS, FS, TS))

3. Distances from: Open Water Body >100 feet | Drainage Way >100 feet | Wetlands >100 feet | Property Line 100+/- feet | Drinking Water Well >100 feet | Other _____ feet

4. Unsuitable Materials Present: ☒ Yes ☐ No If Yes: ☐ Disturbed Soil ☒ Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☒ Yes ☐ No If yes: 102" Depth Weeping from Pit | 102" Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-12	A-fill	Mixed	10YR 2/1	-	-	-	<5	<1	Structureles	Loose	Earth & organic fill - woodchips, roots
12-30	Bw	Loamy Sand	10YR 5/6	34	2.5Y 6/3	<1	<2	<1	Single Grain	Loose	One Depleation - localized change in texture
30-102	C	Sand	2.5Y 6/3				<1	<1	Single Grain	Loose	
102-108 BOH	C2	Silt Loam	5Y 5/1	102	10R 5/8 to 4/6	80-100	0	0	Massive	V. Friable	Varved layers of fine sand &silt loam. HC bands

Additional Notes:
Varved layers likely associated with Lacustrine Plane, overlain by later Outwash Plane deposits

Commonwealth of Massachusetts
City/Town of Montague

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (*minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: TP4 (Hole #) | 4/9/19 (Date) | 11:45 (Time) | Overcast (Weather) | 42.58904 (Latitude) | 72.54883 (Longitude:)

1. Land Use: Vacant - former forest, now grass over fill layer (e.g., woodland, agricultural field, vacant lot, etc.) | Grass (Vegetation) | None (Surface Stones (e.g., cobbles, stones, boulders, etc.) | 0 - 1% (Slope (%))

Description of Location: Level area. Former pine forest destroyed by windstorm. Cleared and grubbed. Organic (wood chips, duff) /earth fill placed over natural outwash deposit.

2. Soil Parent Material: Outwash | Outwash Plane over Lacustrine Plane (Landform) | TS (Position on Landscape (SU, SH, BS, FS, TS))

3. Distances from: Open Water Body >100 feet | Drainage Way >100 feet | Wetlands >100 feet | Property Line 100+/- feet | Drinking Water Well >100 feet | Other _____ feet

4. Unsuitable Materials Present: ☒ Yes ☐ No If Yes: ☐ Disturbed Soil ☒ Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☒ Yes ☐ No If yes: 102" Depth Weeping from Pit | 102" Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA)	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-24	A-fill	Mixed	10YR 2/1				<5	<1	Structureles	Loose	Mixed earth & organic fill
24-30	A-buried	Loamy Sand	10YR 2/1				<1	<1	Single Grain	V. Friable	Buried original A Horizon
30-44	Bw	Loamy Sand	10YR 5/6				<1	<1	Single Grain	Loose	
44-102	C	Sand	2.5Y 6/3				<1	<1	Single Grain	Loose	
102-108 BOH	C2	Silt Loam	5Y 5/1	102	10R 5/8 to 4/6	80-100	0	0	Massive	V. Friable	Varved layers of fine sand &silt loam. HC bands.

Commonwealth of Massachusetts
City/Town of Montague

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (*minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: TP5 (Hole #) | 4/9/19 (Date) | 11:20am (Time) | Overcast (Weather) | 42.587214 (Latitude) | -72.549869 (Longitude:)

1. Land Use: Forest (e.g., woodland, agricultural field, vacant lot, etc.) | Eastern White Pine Trees (Vegetation) | None (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | 0-3% (Slope (%))

Description of Location:

2. Soil Parent Material: Outwash | Outwash Plane over Lacustrine Plane | TS (Position on Landscape (SU, SH, BS, FS, TS))

3. Distances from: Open Water Body >100 feet | Drainage Way >100 feet | Wetlands >100 feet | Property Line >200 feet | Drinking Water Well >100 feet | Other _____ feet

4. Unsuitable Materials Present: ☐ Yes ☒ No If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☐ Yes ☒ No If yes: _____ Depth Weeping from Pit _____ Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-12	A	Silt Loam	10YR 2/1	-	-	-	<1	<1	Single Grain	V. Friable	Topsoil
12-30	B	Loamy Sand	10YR 5/6	-	-	-	<1	<1	Single Grain	Loose	Subsoil
30-84 BOH	C	Sand	2.5Y 6/3	-	-	-	<1	<1	Single Grain	Loose	Natural Sand

Additional Notes:

Commonwealth of Massachusetts
City/Town of Montague

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (*minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: TP7 (Hole #) | 4/9/19 (Date) | 12:00 AM (Time) | Overcast (Weather) | 42.587015 (Latitude) | -72.549832 (Longitude:)

1. Land Use: Forest (e.g., woodland, agricultural field, vacant lot, etc.) | Eastern White Pine Trees (Vegetation) | None (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | 3-8 % (Slope (%))

Description of Location: Wooded area south of Police Station

2. Soil Parent Material: Outwash | Outwash Plane over Lacustrine Plane (Landform) | TS (Position on Landscape (SU, SH, BS, FS, TS))

3. Distances from: Open Water Body >100 feet | Drainage Way >100 feet | Wetlands >100 feet | Property Line ~180 feet | Drinking Water Well >100 feet | Other _____ feet

4. Unsuitable Materials Present: ☐ Yes ☒ No If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☐ Yes ☒ No If yes: _____ Depth Weeping from Pit _____ Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA)	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-12	A	Sandy loam	10YR 2/1	-	-	-	<1	<1	Single Grain	V.Friable	Topsoil
12-30	B	Loamy Sand	10YR 5/6	-	-	-	<1	<1	Single Grain	Loose	Subsoil
30-108 BOH	C	Sand	2.5Y 6/3	-	-	-	<1	<1	Single Grain	Loose	Natural Sand

Commonwealth of Massachusetts
City/Town of Montague

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

Additional Notes:
HC. High chroma concentrations bands

D. Determination of High Groundwater Elevation

1. Method Used:	Obs. Hole #3	Obs. Hole #4
☒ Depth observed standing water in observation hole	102 inches	_____ inches
☒ Depth weeping from side of observation hole	102 inches	102 inches
☒ Depth to soil redoximorphic features (mottles)	102 inches	102 inches
☐ Depth to adjusted seasonal high groundwater (S_h) (USGS methodology)	_____ inches	_____ inches

_____ Index Well Number _____ Reading Date

$S_h = S_c – [S_r \times (OW_c – OW_{max})/OW_r]$

Obs. Hole/Well# _____ S_c _____ S_r _____ OW_c _____ OW_{max} _____ OW_r _____ S_h _____

2. Estimated Depth to High Groundwater: _____ inches

E. Depth of Pervious Material

1. Depth of Naturally Occurring Pervious Material

a. Does at least four feet of naturally occurring pervious material exist in all areas observed throughout the area proposed for the soil absorption system?

☒ Yes ☐ No

b. If yes, at what depth was it observed (exclude A and O Horizons)?	Upper boundary:	30 inches	Lower boundary:	108 BOH inches
c. If no, at what depth was impervious material observed?	Upper boundary:	_____ inches	Lower boundary:	_____ inches

Commonwealth of Massachusetts
City/Town of Montague

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

F. Certification

I certify that I am currently approved by the Department of Environmental Protection pursuant to 310 CMR 15.017 to conduct soil evaluations and that the above analysis has been performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017. I further certify that the results of my soil evaluation, as indicated in the attached Soil Evaluation Form, are accurate and in accordance with 310 CMR 15.100 through 15.107.

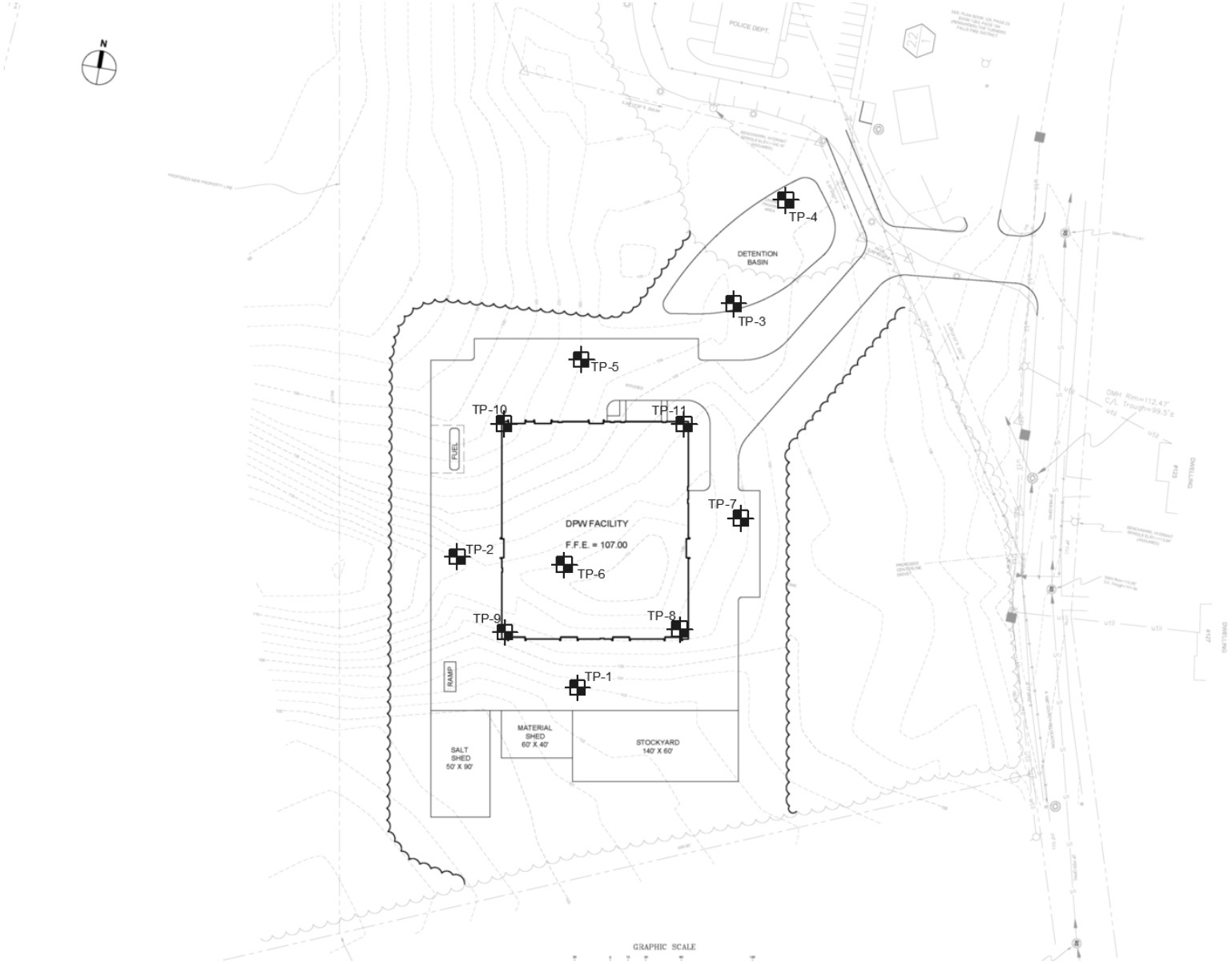
	04/16/2019
Signature of Soil Evaluator	Date
Alton Day Stone #2931	06/30/2019
Typed or Printed Name of Soil Evaluator / License #	Expiration Date of License
No approving authority. Whitnessed by DPW personnel.	NA
Name of Approving Authority Witness	Approving Authority

Note: In accordance with 310 CMR 15.018(2) this form must be submitted to the approving authority within 60 days of the date of field testing, and to the designer and the property owner with Percolation Test Form 12.

Field Diagrams: Use this area for field diagrams:

Commonwealth of Massachusetts
City/Town of Montague

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal



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